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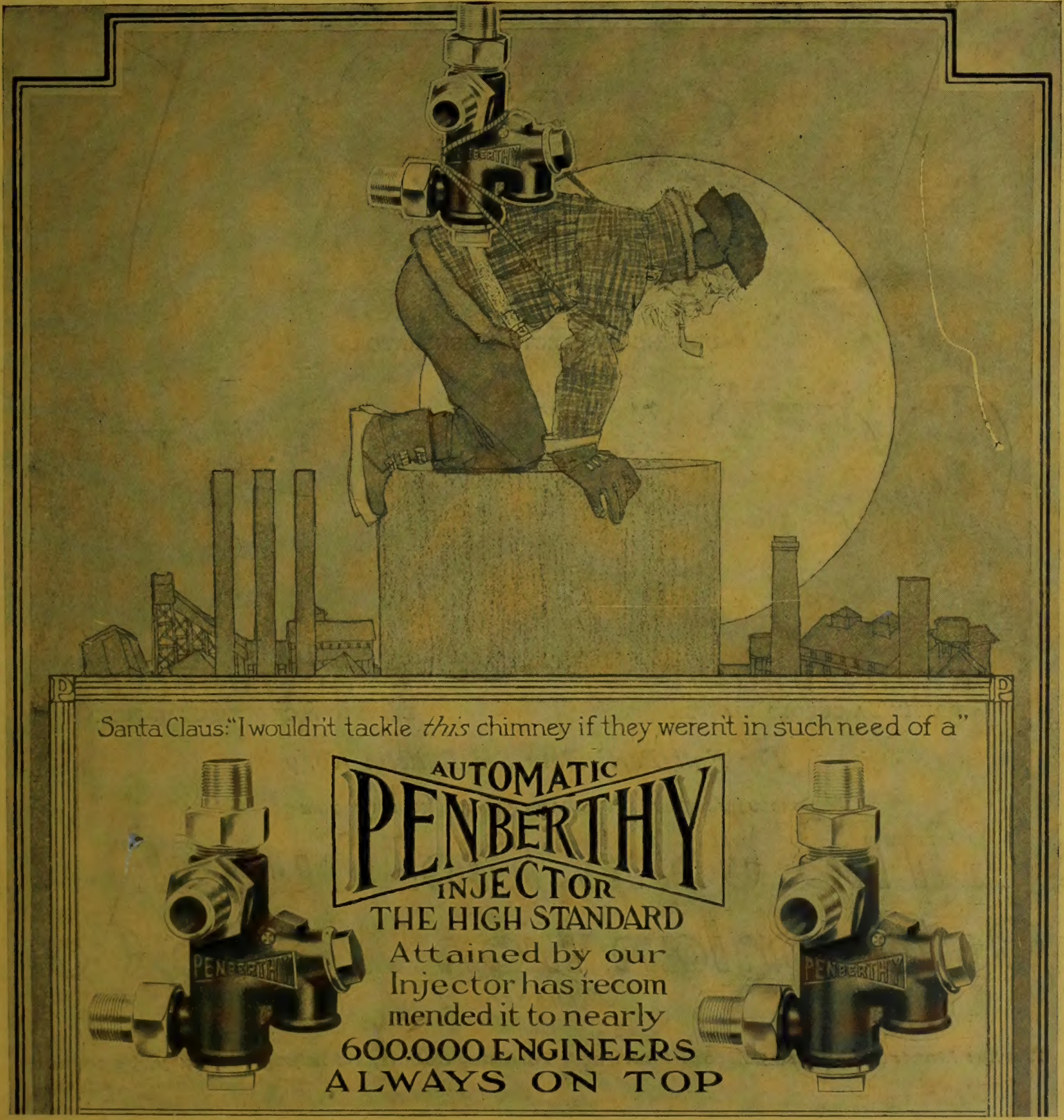
THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Ltd.

MONTREAL: Eastern Townships Bank Bldg. TORONTO: 10 Front St. E. WINNIPEG: 511 Union Bank Bldg. LONDON, ENG.: 88 Fleet St. E.C

No. III. Publication Office, Toronto—January, 1910 No. 1



Santa Claus: "I wouldn't tackle *this* chimney if they weren't in such need of a"

AUTOMATIC
PENBERTHY
INJECTOR
THE HIGH STANDARD
Attained by our Injector has recommended it to nearly
600.000 ENGINEERS
ALWAYS ON TOP

PENBERTHY INJECTOR CO., Limited, - WINDSOR, ONT.

KERR STEAM TURBINE

BUILT IN CAPACITIES FROM 5 H.P. TO 600 H.P.

COMPACT IN FORM
SIMPLE IN CONSTRUCTION
NOISELESS IN OPERATION
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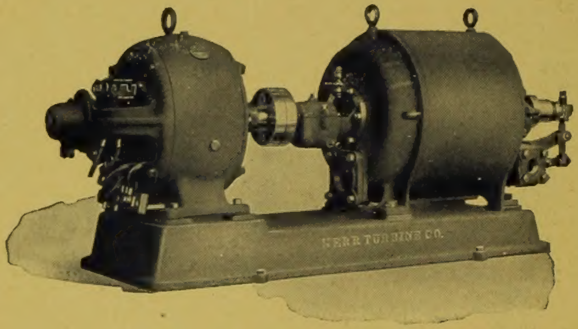
AN IDEAL PRIME MOVER



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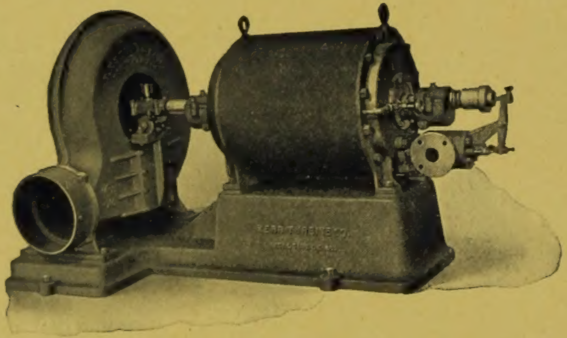

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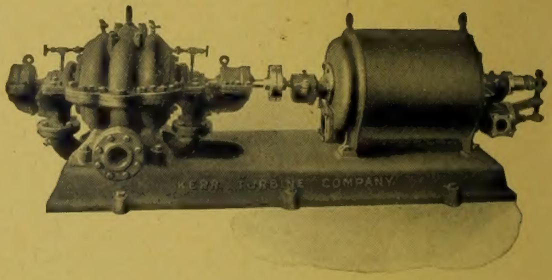

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For Full Particulars See Bulletin No. 7

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Works: Montreal. Sales Offices: Montreal, Toronto, Cobalt, Winnipeg, Calgary, Vancouver

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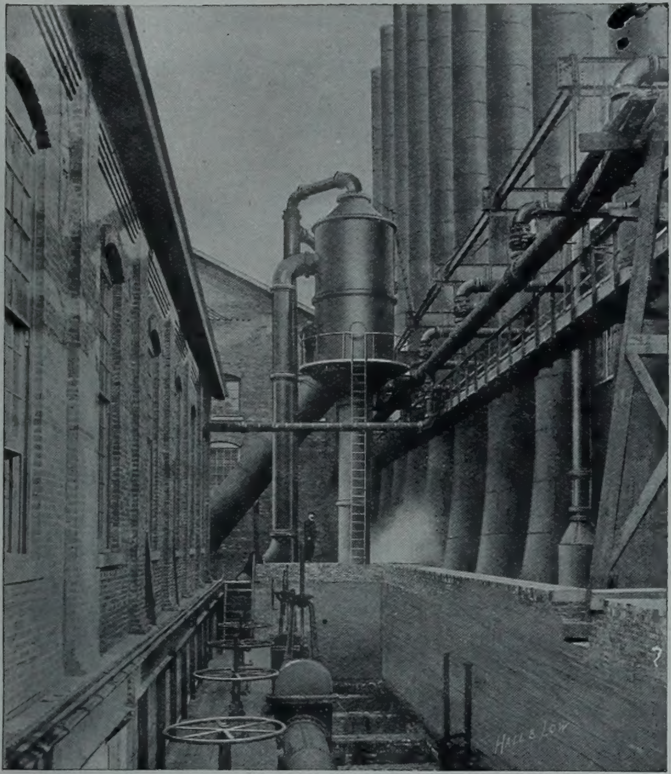
OR CENTRAL CONDENSING SYSTEMS



Where a Medium Vacuum is Sufficient

The
HELANDER COUNTER CURRENT
BAROMETRIC CONDENSER

Connected to Our Patented
Steam Jet Eductor
Will Give Complete Satisfaction

¶ This arrangement will produce and maintain a steady non-fluctuating vacuum of as much as 27".

¶ By making the costly air pump unnecessary it will not only save you 50% of the initial expense of your Condenser installation, but will mean a large cut in your cost of maintenance and operation.

Full information, Plans & Estimates on Request

THE WATEROUS ENGINE WORKS CO., Limited
BRANTFORD, · CANADA.

Quality—Efficiency—Reliability

These, together with reasonable cost, have established the reputation of

Mason Reducing Valves, Pump Pressure and Speed Regulators, Damper Regulators, Balanced Valves.

Reilly Multicoil Feed Water Heaters, Condensers and Evaporators — the most compact and efficient.

It is not what you pay for an article, but what the article pays you in return for its cost, that determines its real value. . . . . .

(Genuine) **Ashton** Pop Valves, Relief Valves, Pressure & Vacuum Gauges, Alarm Gauges.

Berry Safety Automatic Boiler Feed Control—the simplest and best.

Bundy Steam Traps and Separators

We design complete systems for returning condensation direct to the boilers, and we can effect economies in most steam plants.

Catalogues and full information are at your disposal.

PEILER & MACKENZIE, - 52 St. James Street
MONTREAL

Water Power is Cheapest!

Given a fairly good head of water and a Triumph Turbine, there is no power at once so economical and reliable as water power. The reliability and economy of water power depend very largely on the type of wheel used. And, for the greatest economy, combined with the utmost reliability, the best turbine built is the

Triumph Turbine

It is a well-known fact that a single downward discharge turbine gives better results horizontally than a double wheel or centre vent Turbine, because the water discharges freely and is not clogged in any way when the wheel is so placed.

The Triumph Turbine furnishes more power according to diameter, and gives a larger efficiency at all stages of gate-opening, than any other turbine on the market.

The runner or wheel proper tapers from its top to the point where it enters the cylinder. It has wrought steel buckets with cast iron band around the outside of same and we guarantee its durability, as it is stronger than the runner of any other turbine and will stand more rough usage.

The Triumph Turbine has a tight-fitting, easy-working gate, operated by governor, so that the wheel will give an unusually steady motion. For this reason we claim—and our claim is borne out fully by experience—that it gives better results for driving electrical machinery than any other wheel.

An Interesting Illustrated Book

describing the construction of the Triumph Turbine and the method by which it is attached to dynamos and machinery will be sent free to you on request. Write and ask us for Book P.H.

The Madison, Williams Mfg. Co., Limited
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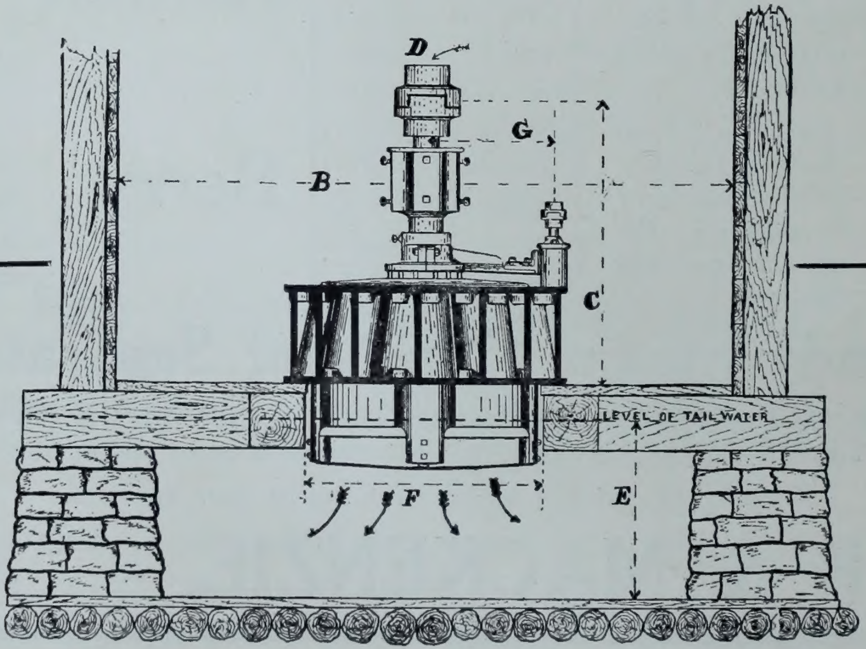
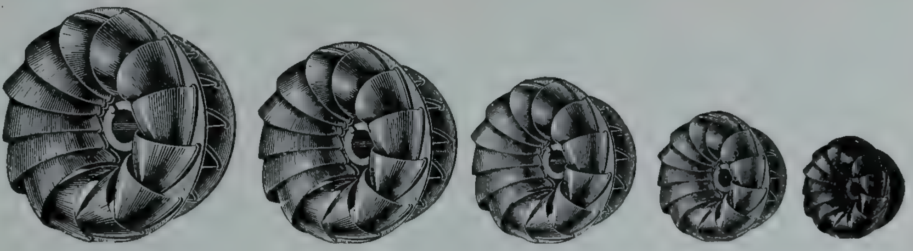




Power

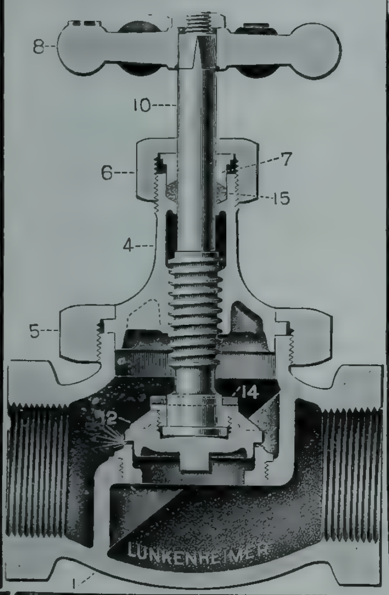
Don't let that Water Power go to Waste

Turn it into Money with our Improved Turbines. Good Turbines don't cost any more than poor ones. Why not get the best? We guarantee Highest Power and Efficiency, and if a standard arrangement won't fill the bill, we design a special one after studying the conditions.

CONSULT US. IT PAYS!

THE JENCKES MACHINE COMPANY, Limited

GENERAL OFFICES: Sherbrooke, Quebec
WORKS: Sherbrooke, Quebec; St. Catharines, Ontario
SALES OFFICES: Sherbrooke, St. Catharines, Cobalt, Vancouver, Montreal, Rossland



The SEAT in this valve is SELF-CLEANSING, both DISC and SEAT are RENEWABLE, but can also be REGROUND. These Features make the

LUNKENHEIMER "RENEWO" VALVE

practically indestructible, and outlast the life of the pipe. The seat is made of a HARD, CLOSE-GRAINED NICKEL, and is very durable. All other parts are made of the highest grade of bronze composition.

WRITE FOR CATALOG

"Most supply houses sell them, yours can; if they don't or won't, tell us."

The LUNKENHEIMER CO.

LARGEST MANUFACTURERS OF HIGH-GRADE ENGINEERING SPECIALTIES IN THE WORLD

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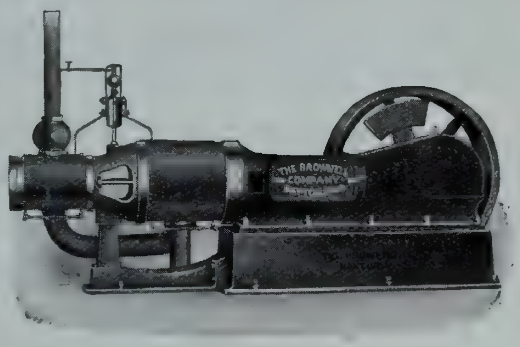

The Brownell Company

Dayton, - Ohio

Branch Offices:

401 Bank of Commerce Bldg., St. Louis, Mo.
925 Monadnock Bldg., Chicago, Ill.

Manufacturers of

Boilers, Engines and Feed Water Heaters

We make a specialty of Enclosed Splash Oiling Engines for Direct Connecting to Generators.

Four features
at least
must have
prominence
in the boilers
of an up-to-date
steam plant.

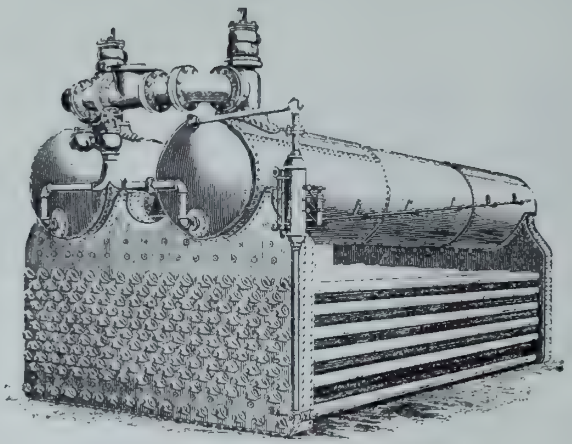

Fig. 2.—The Heine Boiler Without Brick Setting

1. **Capacity of absorption and transmission of heat.**
2. **Dryness of steam**
3. **Safety at high pressure.**
4. **Precipitation of scale and mud.**

And in no other Boiler have these essential features so much prominence as the

Heine Safety Boiler

The HEINE BOILER is not only constructed so that it will best absorb and transmit the heat, but also so that the heat will best reach it. Careful selection and testing of materials guarantees perfect safety at high pressures, the boiler as a whole being submitted to a rigorous inspection and test before it leaves our shops. Dryness is obtained by an active agent present at all times in the boiler, which becomes more vigorous the more the boiler is pushed. The HEINE MUD DRUM most effectively precipitates and discharges all scale and mud. Our literature will interest every actual or prospective Boiler Purchaser.

POLSON
IRON
WORKS
LIMITED
Toronto, Can.

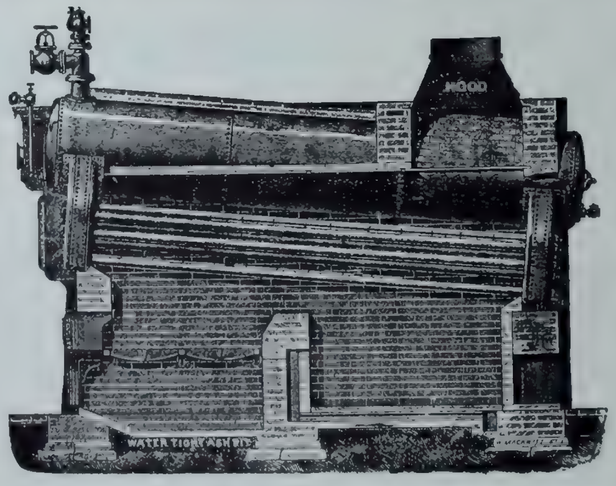

Fig. 1—Heine Boiler and Setting

Write for it to-day.

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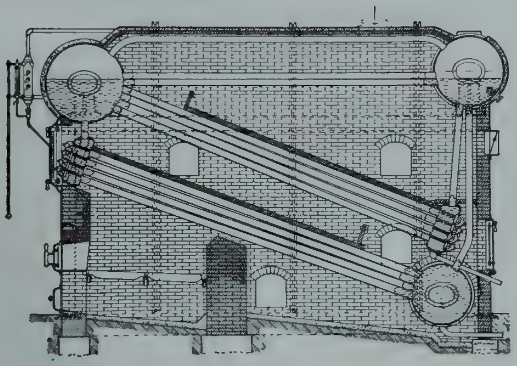
Watson Jack & Co.
709 Power Bldg.
MONTREAL

ROBB WATER TUBE BOILER



Straight tubes

Perfect water circulation

Dry or superheated steam

Half the usual number of handholes

Robb Engineering Co., Limited, Amherst, N.S.

DISTRICT OFFICES
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- Traders Bank Building, TORONTO; Wm. McKay, Manager.
- Union Bank Building, WINNIPEG; W. F. Porter, Manager
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FLEMING GRATE BARS and Diamond Smoke Consumer

together will accomplish higher results in economy of fuel and eliminate the smoke nuisance.

Installed on 30 days' trial

APPLY—

BUTTERWORTH FOUNDRY
LIMITED
BROAD STREET, OTTAWA

or F. W. Donaldson, 422 Euclid Avenue, Toronto

Genuine
"Detroit"-Improved
Standard
Lubricator

Send for
Catalog A58
Illustrating
339 Types-Sizes

Simple in theory.

All that skill and money can produce in construction.

Dependable in practice.

Every "Detroit" Lubricator is carefully inspected before shipping.

The first "Sight Feed" Lubricator was originated by the Detroit Lubricator Co. over thirty years ago.

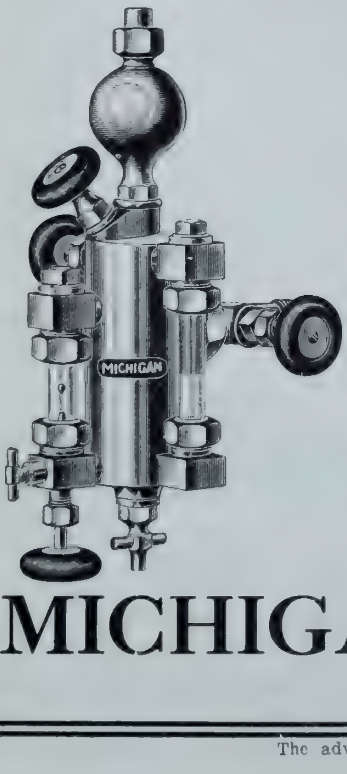
To-day we operate the largest plant devoted to the manufacture of Lubricating Devices in the World.

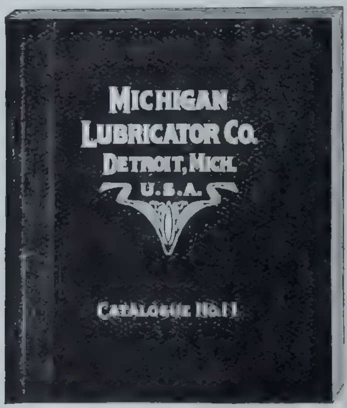
Be sure you get the Genuine "Detroit".

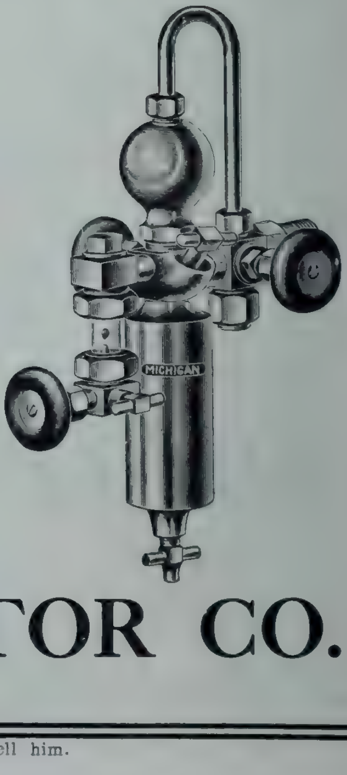
DETROIT LUBRICATOR COMPANY.
DETROIT, U.S.A.

MICHIGAN

Illustrated catalog mailed to you free



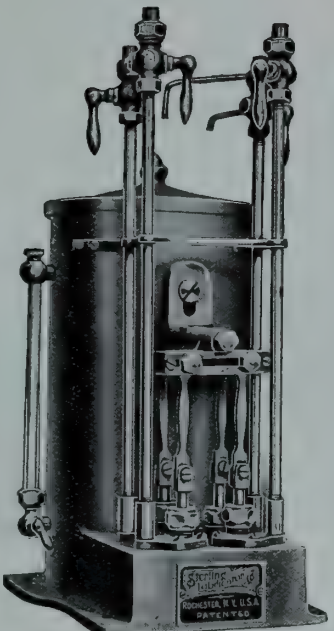




WRITE TO-DAY

MICHIGAN LUBRICATOR CO.
DETROIT, MICH.

STERLING FORCE FEED LUBRICATORS



THEY WON'T

WASTE oil in the drop per minute system.

THEY WILL SAVE

30%—Thirty per cent.—30% Over Hydrostatic Lubrication.

YOU SHOULD

Investigate, Ask, Inquire.

WE WILL

SEND Special Souvenir, Information, Discounts, etc., etc.

30 Days' Free Trial.

Scott, Campbell & Co , 65 Victoria St.
Phone M. 4034

Agents for **STERLING LUBRICATOR CO.**
"8 FRANK" STREET, ROCHESTER, N.Y.

"HERE'S THE POINT"

In an Oiling System where trouble often begins with clogged valves--dirty, leaking or broken sight feed glasses – one of these plain, neat Richardson Sight Feeds will fill all requirements efficiently.

They are made for one, two, three or four pipe connections —Union-Cinch type—(Bulletin No. 210). May be placed in series or at the end of the pipe lines.

Advance Sheet No. 114
Something Interestingly new!

THE SIGHT FEED OIL PUMP CO.
MILWAUKEE, WIS.

I am using

"Maple Leaf" Cylinder Oil

¶ And I find it reduces my lubricating troubles immensely.

¶ That's what makes me happy.

¶ It would make **you** happy, too!

¶ Try it!

"Maple Leaf" Cylinder Oil

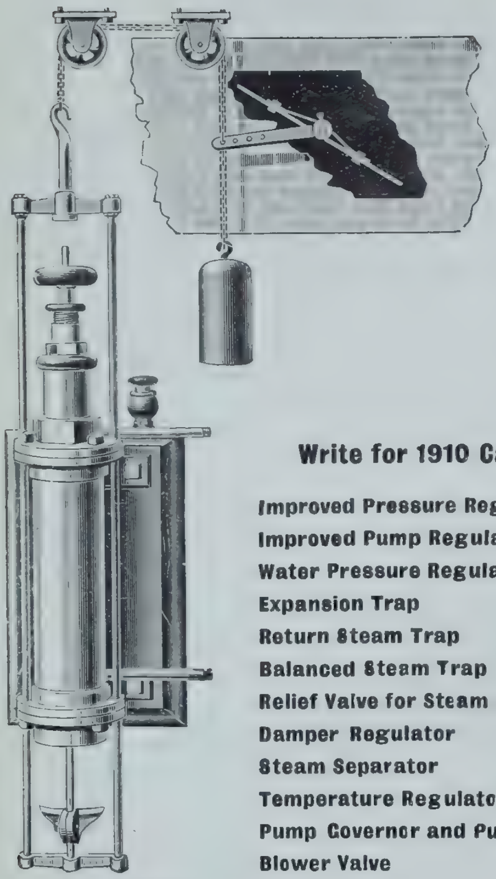
is guaranteed to lubricate perfectly at less cost than any other Cylinder Oil on the market.

¶ And it **fulfills** the guarantee.

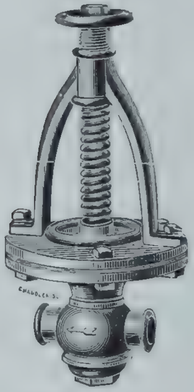
¶ A postal from you will bring, by return mail, a very interesting pamphlet about "Effective Lubrication."

Canadian Oil Companies
LIMITED
TORONTO
Distributing Depots at all points in Canada

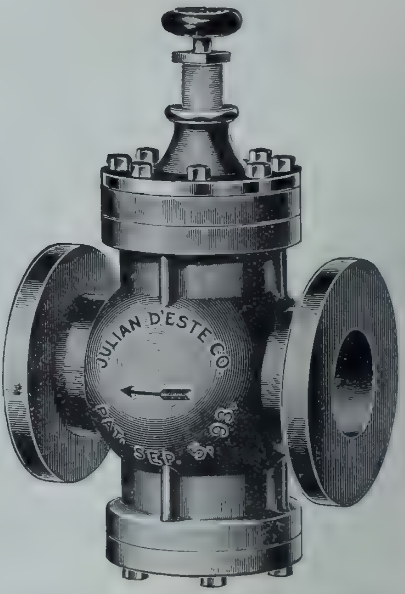
Curtis Engineering Specialties



Improved Damper Regulator



Water Pressure Regulator



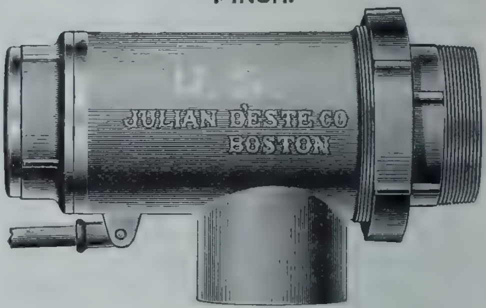
Improved Steam Pressure Regulator

Write for 1910 Catalogue

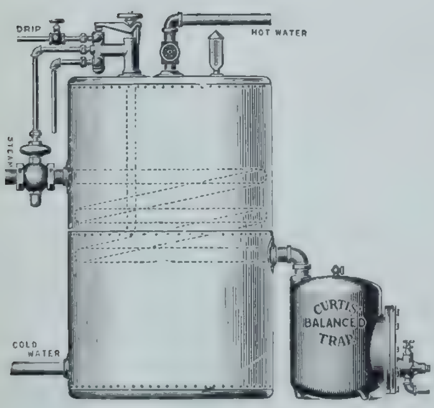
- Improved Pressure Regulator
- Improved Pump Regulator
- Water Pressure Regulator
- Expansion Trap
- Return Steam Trap
- Balanced Steam Trap
- Relief Valve for Steam and Water
- Damper Regulator
- Steam Separator
- Temperature Regulator
- Pump Governor and Pump
- Blower Valve
- Cellar Drainer
- U. S. Ball Cock.

If you are an Engineer write for the d'Este Manual

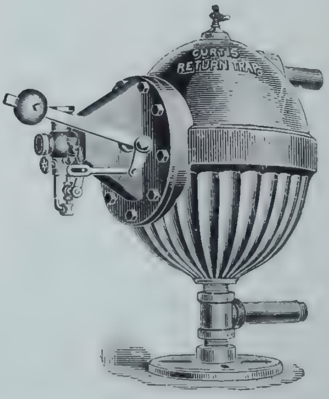
4 INCH.



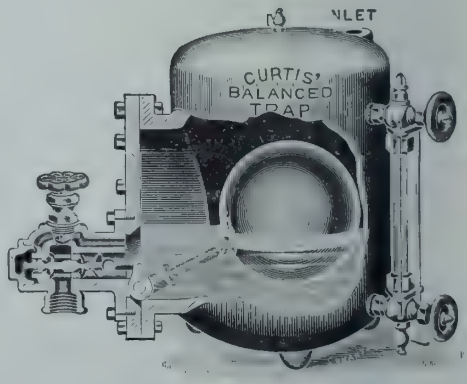
U. S. Ball Cock



Temperature Regulator



Return Steam Trap

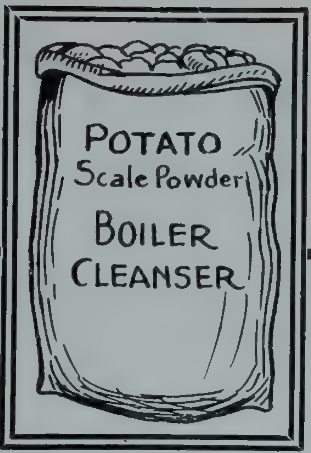


Balanced Steam Trap

JULIAN D'ESTE COMPANY

24 CANAL STREET - - - - - BOSTON, MASS.

The advertiser would like to know where you saw his advertisement—tell him.



Decrease your fuel bills

by preventing scale formation in your boiler. You can effectively do this by treating your feed water with

POTATO SCALE BOILER CLEANSER

Scale is the engineer's worst enemy and the logical way to obviate it is to treat the scale-forming elements in your feed water. Send me a sample of your water. I guarantee I can chase away all scale for you.

Sole Agent for America

C. C. SNOWDON
CALGARY, ALTA.
Branch Stores in New York and Montreal. Address all letters to Calgary

WALKER'S
ELECTRIC BOILER
COMPOUND

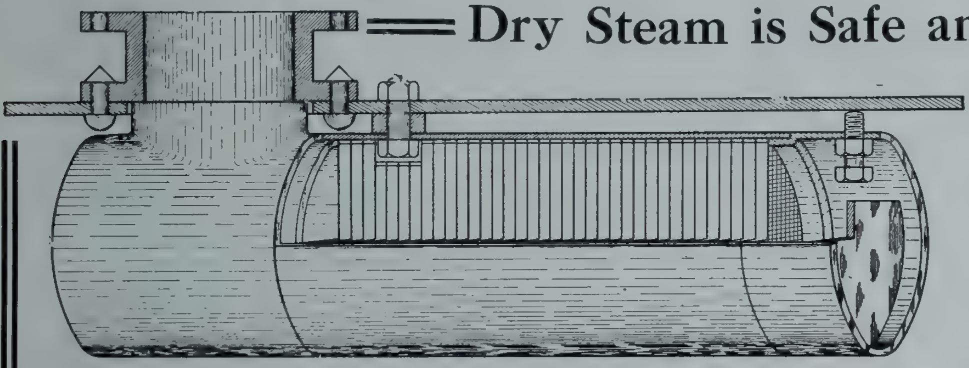
ALSO:

Regal Valve Oil
Red Star Cylinder Oil
Monarch Cylinder Oil
Superior Engine Oil
Electric Engine Oil
Vulcan Machine Oil
Heavy Red Machine Oil
Brush Dynamo Oil
Gas Engine Oil and
all Engine Supplies

WRITE FOR PRICES

The Electric Boiler Compound Co., Limited Guelph, Ont.

Dry Steam is Safe and Economical



THE
IDEAL
INTERNAL
STEAM
SEPARATOR

Makes for economy by saving oil, packing and time, and by lessening wear and tear on engines, pumps and compressors. It will safeguard your engine against damage through water-shock and the going-out of cylinder heads.

REMEMBER THE FIRST COST IS THE ONLY COST!

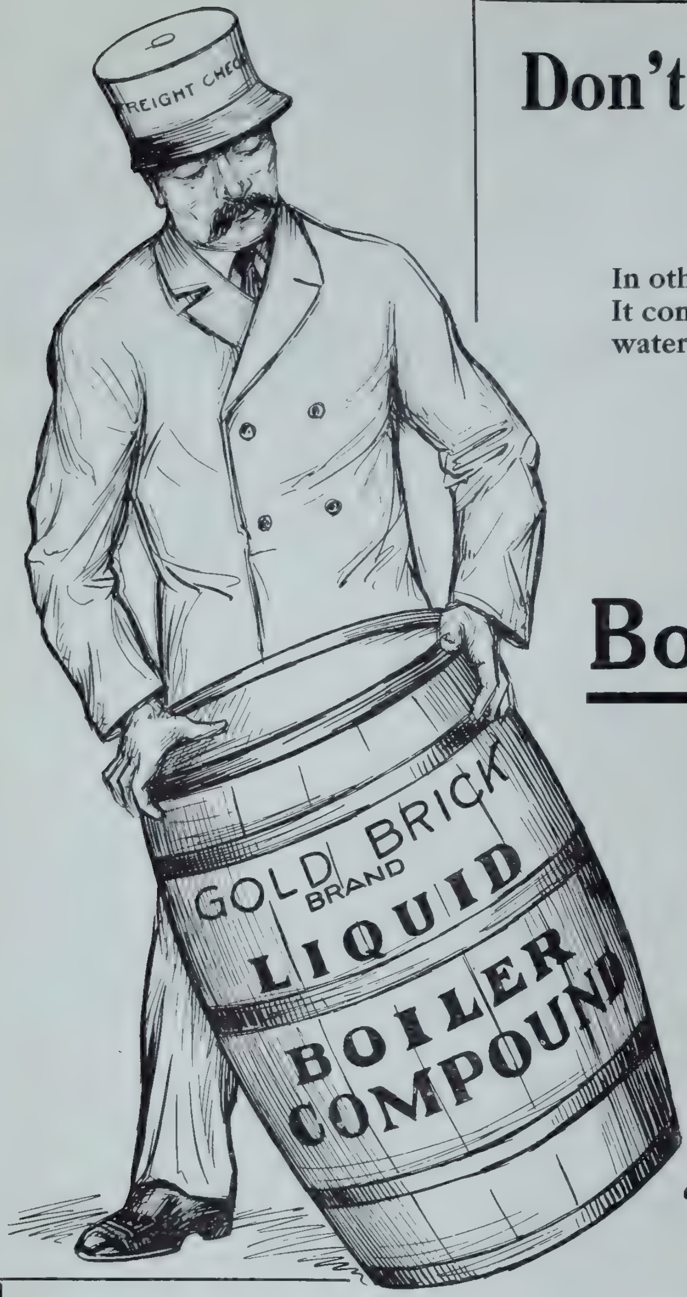
The "Ideal" requires no subsequent attention. Write for booklets.

IDEAL STEAM SEPARATOR AND SUPPLY CO.

820 Euclid Avenue, TORONTO, Canada

We are Selling Agents for:
WATSON & McDANIEL CO., Philadelphia, (Steam Traps, etc.)
HARRIS SMOKELESS FURNACE CO., Nashville, Tenn.
WRITE FOR CATALOGUES

Other lines, each having distinctive features:
POTTER SEPARATORS; WHALEY AUTOMATIC SMOKE PREVENTERS; LEONHARDT GAUGE GLASS PROTECTORS
WRITE FOR DETAILS AND PRICES



Don't Pay Freight Charges on Water!

In other words, DON'T buy liquid boiler compound. It consists mainly of just the same kind of ordinary water that you can draw FREE from your own tap.

Instead, buy

"Red Star"

Boiler Compound

It is in powder form, packed in 5 lb. bags. One five-pound bag of "RED STAR," dissolved in one gallon of boiling water, makes 21 lbs. of liquid compound that is positively unequalled in efficiency.

We guarantee it to free your boiler from all old scale and to prevent absolutely the formation of any new scale.

If it fails we will refund your money cheerfully and promptly.

"Red Star" is not a stock compound

It is made specially after your feed water has been analyzed by an expert chemist. At the same time it costs you far less than many people will charge you for a stock compound that is 90% just plain water.

To every user of "Red Star" compound we will furnish an

——Automatic Feeder Free——

Hygienic Laboratories Limited
11 Colborne Street
Toronto——Ontario

Winnipeg Representative—Francis Sedziak, 780 William Avenue
Montreal Representative—W. S. Chandler, 5 Thistle Terrace

SPECIAL OFFER

send us a gallon of your feed water by express and we will analyze it for you

FREE

Send it along to-day.

THE GARLOCK PACKING CO. TRADE GARLOCK MARK HAMILTON CANADA.

There is Only One Make of

GARLOCK PACKING

It is made at Hamilton, Canada—and has been for 25 Years—by the Garlock Packing Company.

Don't run risks by accepting any substitute for the real Garlock Packing.

Write us for quotations on all packings you require or wait for the real Garlock salesman to call on you.

THE
Garlock Packing Co.
HAMILTON - - ONTARIO

Do you realize what the factory stands for when you buy its product??

Just think this question over when your valve troubles are worrying you

As to Valves :—

All regular styles and sizes of these iron body, brass-mounted valves are now made in our New Montreal Plant.

Can be packed when under pressure and wide open.

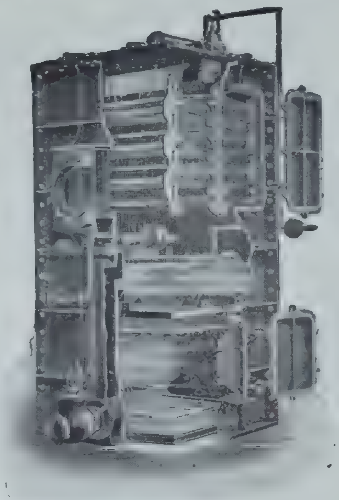
All parts are interchangeable, workmanship and finish guaranteed, or in other words, "THE BEST VALVES MADE."

Send for Catalogue

JENKINS BROS. LIMITED
102 St. Remi Street - - - MONTREAL

The **WEBSTER Feedwater Heater, Purifier and Filter**

will positively rid your boiler of all scale by removing all scale-forming elements from your feedwater. It also makes use of all condensations and waste steam. By using this purified water you get every ounce of power out of your boiler, with a less consumption of fuel.



MORE WORK FOR LESS MONEY.

Literature on Request.

Darling Brothers, Limited

Montreal Toronto Winnipeg

Vancouver, B.C.—Frank Darling, Agent.

THE DART FLANGE UNION HAS THE BRONZE TO BRONZE GROUND JOINT

NO PACKING

Required and it seats itself in or out of line

NEVER LEAKS

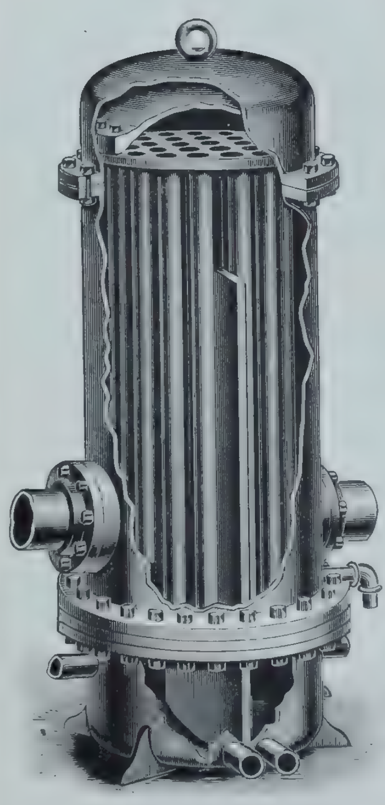
Or needs attention

GUARANTEED

DART UNION CO. Ltd.

TORONTO, - ONT.

A GUARANTEED FEED WATER HEATER!



Do You realize what that means? It means that back of every heater we make stands a reputation of efficient service and proven results. If we were not SURE of our heater we could not afford to guarantee it. Just read this list of some of the features.

Lack of Sediment Troubles, Unbreakable Construction, Cast Iron Shell (No Rivets to Corrode), FREE Expansion, Easily Accessible for Cleaning.

ALL THESE AND MORE. WRITE US.

Chas. Jacobs & Co., Boston, Mass.

30 OLIVER STREET.

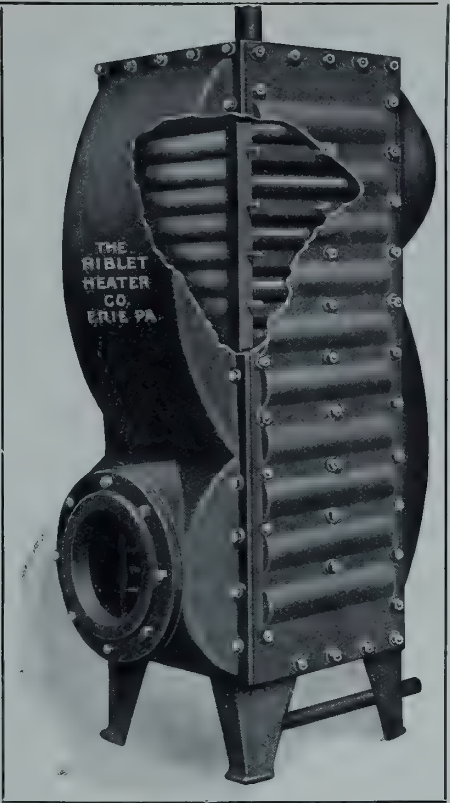
The Transverse Current Water Heater

Decrease Your Fuel Bills

by supplying your boiler with heated water. We can save you hundreds of dollars each year if you will install the

Transverse Current Water Heater

which will make use of a large part of the heat value of your fuel now being wasted.



Some Leading Features

¶ Made of cast iron, it does not corrode easily.

¶ No tubes to scale. No joints to leak. No floats to require attention.

¶ Practically self-cleaning. All passages easily accessible.

¶ No oil separator needed and can't get out of order.

¶ Send for descriptive booklet.

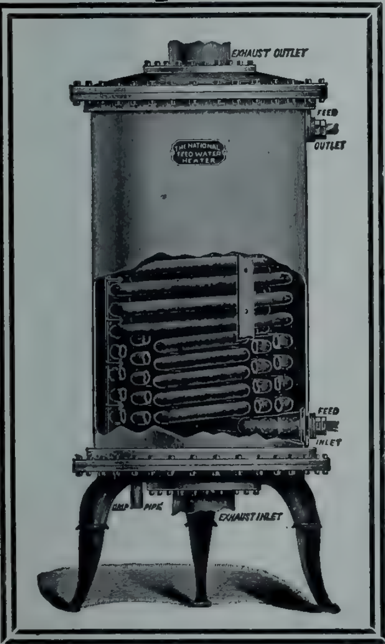
The Riblet Heater Co.
Box 18
Erie - - - - - - - - - Pa., U.S.A.

The Standard Engineering Company, Limited
General Agents for Canada
47 Wellington St. E. - - - - - - Toronto

The Best Because it is the Simplest!

THERE ARE NO FREAK FEATURES ABOUT THE

NATIONAL FEED WATER HEATER



Many heaters depend upon some abnormal feature to promote their sale. The "National" sticks to a plain common-sense principle, which guarantees the highest efficiency and the greatest reliability. No inside joints to leak, no leaky straight tubes, no back pressure, no contact of the water with shell or iron. That's what you find in the "National" Seamless drawn brass or copper tubing. Over 2,700.000 H.P. in daily use.

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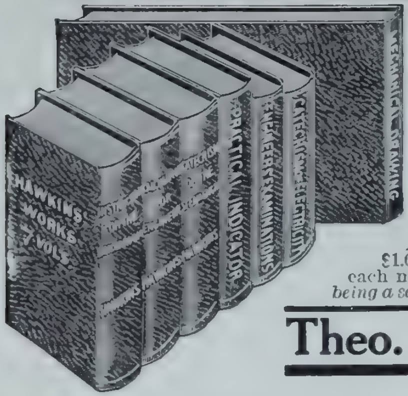

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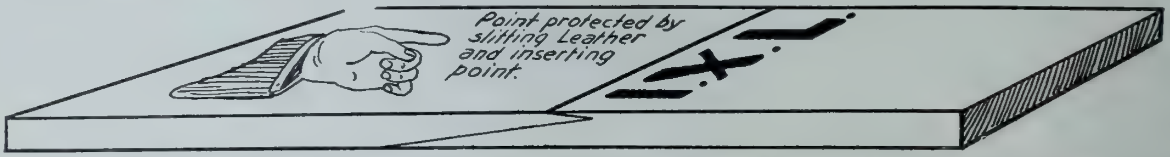

The great trouble with *any* belting—no matter how good the leather—that is joined up with the ordinary splice, is the fact that the splices come open, causing loss and delay. J. D. McArthur's Leather Belting made with the "I.X.L." SPLICE, as shown in this cut, *cannot* come open at the splices. Note the protected point, outside point running same direction as pulley. J. D. McArthur's Leather Belting is made from Prime British Oak-Tanned Leather, from Close-Trimmed Backs exclusively.

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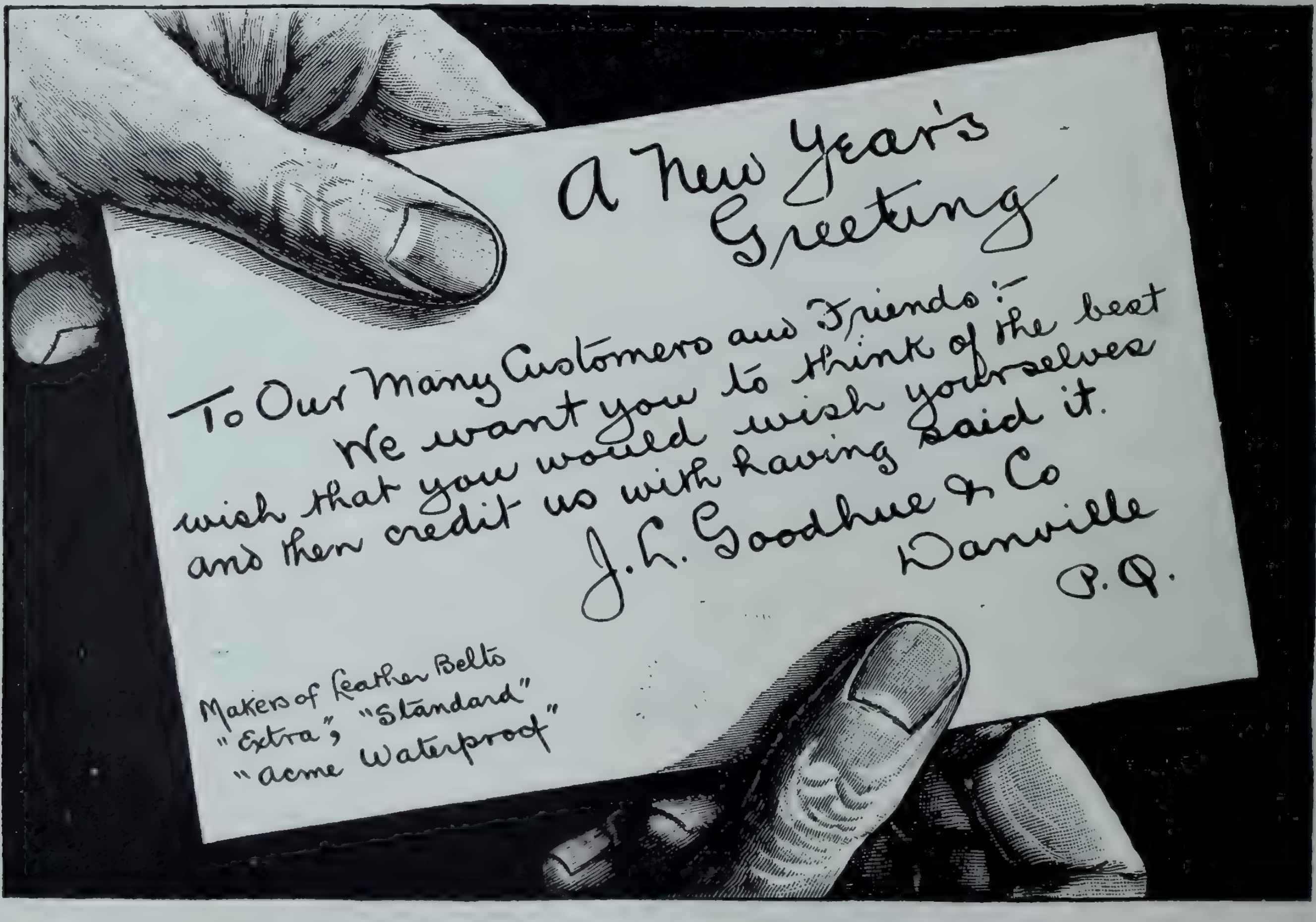

A New Year's Greeting

To Our Many Customers and Friends:—
We want you to think of the best wish that you would wish yourselves and then credit us with having said it.
J. L. Goodhue & Co
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Makers of Leather Belts
"Extra", "Standard"
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ONLY THE BACKS OF THE HIDES
ARE USED IN MAKING
THE D.K.McLAREN LEATHER BELTS

The Best Belting in the World

is none too good for the man who wants continuous service.
This sort of service is given by

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GENUINE BRITISH OAK TANNED

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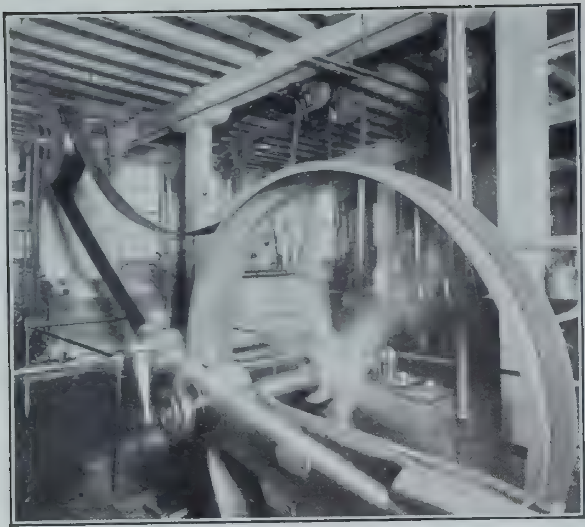
Full stock of Our "Extra C" Leather Belting and "D.K" Balata at above addresses



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For Canadian Belts

There is, without doubt, more Cling-Surface used in Canada than the total of all other materials.

Because only Cling-Surface will permit all belts and ropes to be run easy or slack and carry full loads, and at the same time make and keep them pliable, water-proof and preserved.

It contains no rosin and is not sticky, but penetrates *into* the belts and ropes, where they need it.

The running of belts slack means ease on belts, bearings, shafting and engine, cool bearings, economy of oil, saving of the time and labor in keeping belts tight and increased power at machines.

This belt has run 6 years in the I.X.L. Laundry, Toronto, with Cling-Surface, in heat and steam. It is 9" leather, 8' to 42" pulleys, 17' centers, 45 H.P. load when photographed, 2050 ft. P.M. 40" slack, and never slips.

We guarantee Cling-Surface to give you the best belt service you ever had. We quote f.o.b. Toronto, duty paid. Write for special trial terms and printed matter. Write now.

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You May Have One of these Speed Indicators without Spending a Cent

if you are a subscriber to "THE POWER HOUSE," by sending two new paid-up subscriptions ; If you are not a subscriber, send in your own subscription together with two others, and the indicator will be mailed to you immediately.

STARRETT HIGH SPEED
INDICATOR, No. 104
Value $1.00
Given for two yearly
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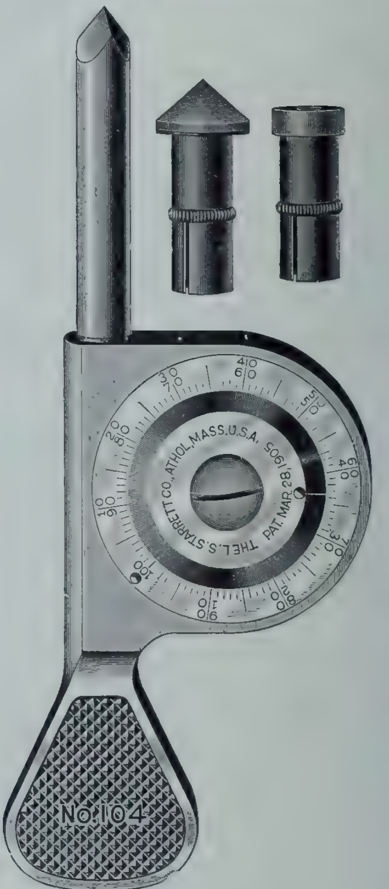
THE L.S. STARRETT CO. ATHOL, MASS. U.S.A.
PAT. MAR. 28, 1905
No. 104

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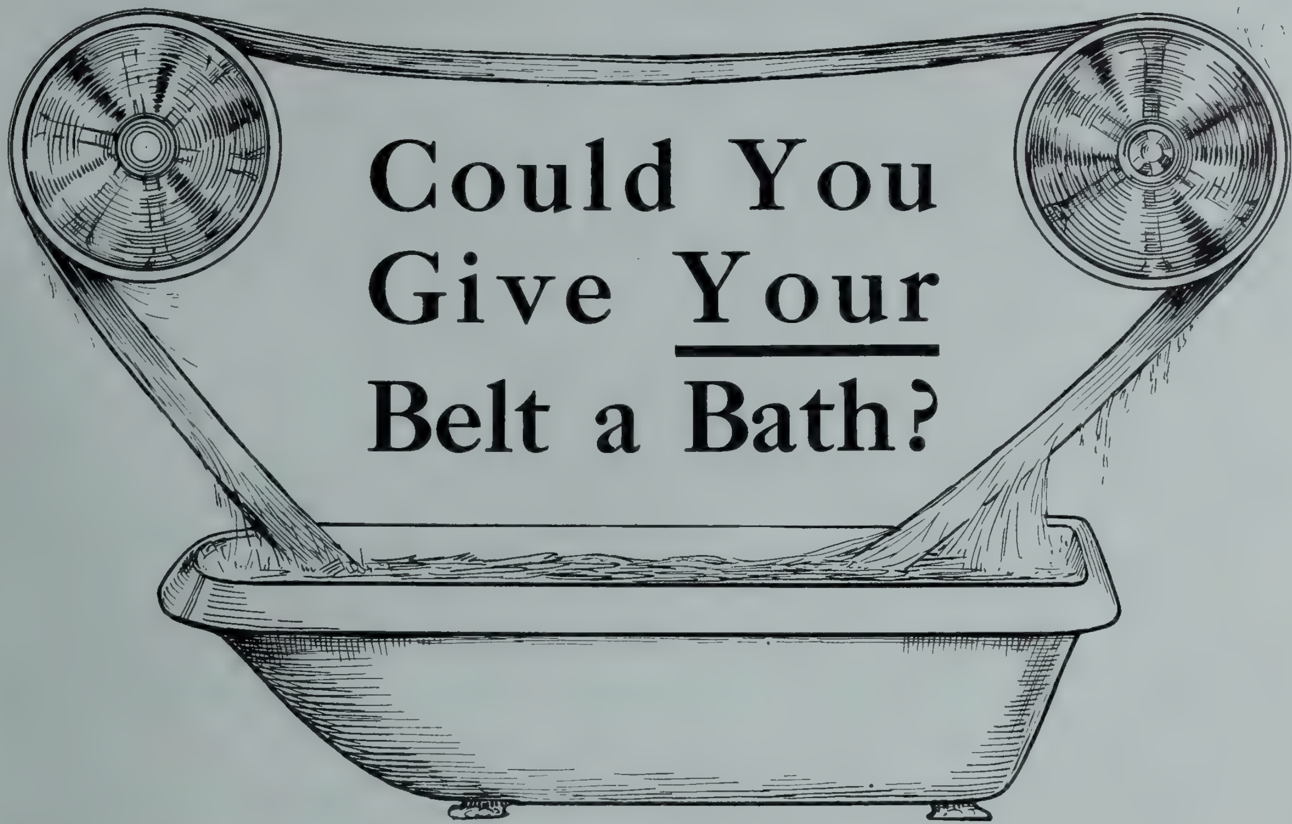


Could You Give Your Belt a Bath?

If it were

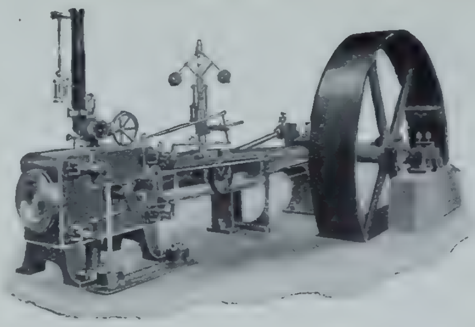
"AMPHIBIA"
(WATERPROOF)

it would do the belt good rather than ruin it, which latter catastrophe would probably happen if your belt is NOT "AMPHIBIA" (WATERPROOF)

If you have any steam or moisture laden atmosphere and want to run a belt there, get the right kind FIRST. Don't experiment. You will eventually use "AMPHIBIA" (WATERPROOF) so START right.

Sadler & Haworth
ESTABLISHED 1876

Factories at Montreal and Toronto - Stock Depots: St. John, N.B., Winnipeg, Calgary, Vancouver



Girder Bed Corliss Engine

Catalog on application

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242 Becher Street Milwaukee, Wis., U.S.A

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CORLISS ENGINES

Simple or Compound, Girder or Heavy Duty Bed. Any size 30 to 1000 H.P.

Ice and Refrigerating Machinery

THE LINDE {AMMONIA and CARBONIC ACID} **SYSTEMS**

For Cold Storage and Ice Making Plants

Patent Seamless **CORK INSULATION**—Efficiency With Economy

Send for our catalogue showing details of installations and containing many useful tables and other data concerning this industry.

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COMPLETE PLANTS DESIGNED AND INSTALLED

EVERY ENGINEER

SHOULD KNOW

ALL ABOUT

WEARWELL LEATHER PACKINGS

You have packing troubles and have never known where to procure Packings that would give satisfactory service. We manufacture "Wear Well Leather Packings" from the highest quality of leather, work to your specifications and guarantee every Packing to give satisfaction.

Made in all sizes and styles for use in Hydraulic and Compressed Air Machinery. Write for descriptive booklet.

Detroit Leather Specialty Company, Inc.

DETROIT 87 Beecher Avenue MICHIGAN

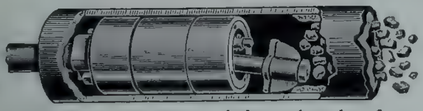
ECONOMY IN BOILER MANAGEMENT

depends upon the method of boiler cleaning employed. Perhaps you'd like to know how to promote economy in YOUR Boiler room. We've been in the boiler cleaning business 12 years and we think we know a few things along this line which you may not. For instance, we have learned that compounds neither prevent nor remove scale. Then we know that

The Dean Boiler Tube Cleaner

will remove enough additional scale from the boilers you think clean to save its cost in six months or less. You may never know how much you are losing because of scale until we show you how much we can save you.

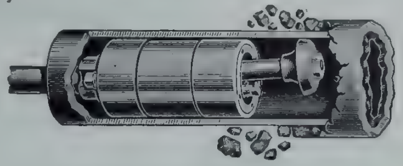
Write to-day for "Scale Removal Made Easy" and our free trial offer.



The Dean removing scale from the tube of a water tube boiler.

THE WM. B. PIERCE CO,

330 Washington Street, Buffalo, N.Y.



The Dean removing scale from the tube of a return tubular boiler.

The Nichols Chemical Company, Limited

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ACIDS AND CHEMICALS

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TRI-SODIUM PHOSPHATE

Purest Commercial, 100%, for prevention of scale in boilers.

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"STEEL MIXTURE"

The ideal material for boiler settings. It is hard as well as heat resistent. Our large stock, from which we can ship quickly and at the minimum expense, consists mainly of the following:—Boiler Door Arches, designed with few joints and the proper flare; Large Blocks, tongued and grooved, for lining the fire-box. A patent Back Arch that is both simple and durable. Water tube as well as Horizontal boilers are fitted with our goods. Write for our booklet.

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McLEOD & HENRY CO.

MAIN OFFICE & WORKS
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The most satisfied people in America are the manufacturers using——

Morehead Steam Traps

Mr. Manufacturer, if you were shown:

¶ That by the installation of a good tilting steam trap you would effect a saving in fuel sufficient to pay for the trap in from three to six months.

¶ That you would **increase** the efficiency of your steam lines by draining them of all condensation.

¶ That this pure hot condensation could be returned to the boilers as feed water by means of this trap without the assistance of pump or injector.

¶ Would it not be a matter of considerable import to you?

The MOREHEAD Tilting Return Steam Trap will do this and more.

Mr. Engineer:

¶ The quickest, surest way of convincing you that the Morehead Trap will merit your recommendations is to have one shipped on trial.

¶ The operation of the Morehead is so simple and natural that nothing can get out of repair.

¶ You won't have to sleep with a repair kit under your pillow.

¶ There is no wastage (blowing) of steam at the outlet—the absolute water seal prevents that.

¶ Write us your conditions—this incurs no obligations.

¶ Make use of our quick system for mailing "Trap Book." Send postal to-day.

MOREHEAD MFG. CO.

Dept. "J" Detroit, Mich.

CANADIAN REPRESENTATIVES:—A. R. Williams Machinery Co., Toronto; W. H. Markle, Montreal; Park Bros., Chatham, Ontario

NOTICE TO STATIONARY ENGINEERS

Every Certificate holder who intends to renew his Certificate should register with the Board not later than the First day of December, 1909, on a form which will be supplied. Any one who has not registered by the First of February, 1910, will not be granted a renewal only on the payment of the fee of Five Dollars.

I would also request those who have changed their address since receiving their certificate for 1909, and have not notified the Board, to do so at once.

W. C. McGHIE,
Chairman,
Parliament Buildings, Toronto

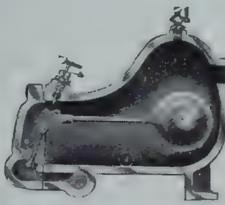
McDANIEL IMPROVED **STEAM TRAP**

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig St., MONTREAL, CAN.

IDEAL STEAM SEPARATOR & SUPPLY CO.
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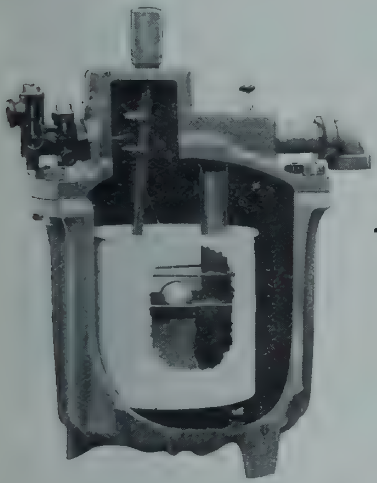


A Return Steam Trap with 40 Years' Concentrated Effort

Behind its reputation

Isn't it only logical to suppose that the man who invented the first return trap, and has concentrated on its improvement for over 40 years, can say that his trap leads all the rest and say it with conviction?

Each and every one of our traps is made under the personal supervision of the inventor of the first return steam trap.

The Albany Steam Trap Co., 319 N. Pearl St., Albany, N.Y.

Sold on a Positive Guarantee

The distinctive and controlling feature of the

Duffy Steam Trap

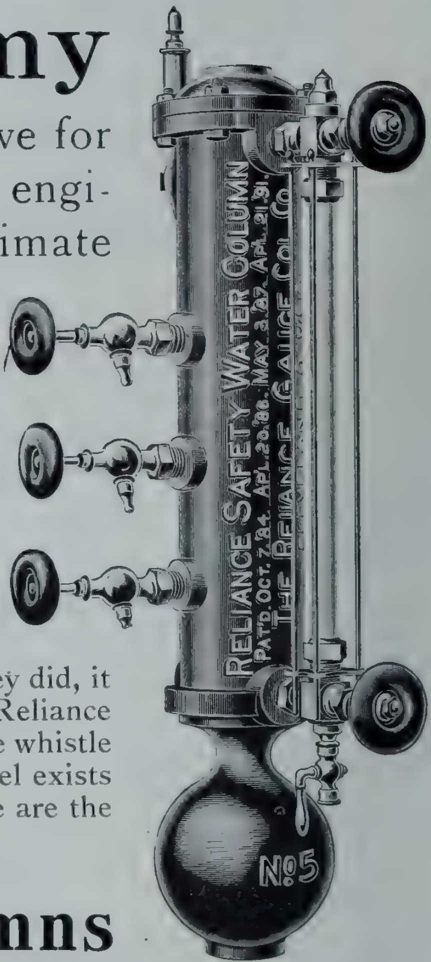
lies in the expansion and contraction of ordinary iron pipe in coil, as shown in cut. This apparatus, patented in nearly all civilized countries, approaches nearer the ideal sought after by engineers than any other trap on the market. It is simple of construction, occupies small space, and possesses large draining capacity. It will drain system when steam is shut off, thus preventing danger from freezing. Guaranteed to work perfectly on all steam pressures from 5 to 200 lbs.

Let me send you my fully descriptive booklet or let me send you one of my traps on 30 DAYS' FREE TRIAL. I know it will do what I claim for it! Write me.

FRANCIS DUFFY, 136 Stuart Street, Kingston, Ont.

Boiler Room Economy Plus Safety

That's what you strive for—what every good engineer strives for, because in no other way can ultimate success be attained. But in these days of modern inventions and perfected machines no man does the work of a machine, if the machine can do it better and at lower cost. You could, of course, instruct your firemen to watch the water line of your boiler and keep it steady. You could tell them to sound a signal whenever the water line became too high or too low.


RELIANCE SAFETY WATER COLUMN
PAT'D OCT. 7.84. APL.20.86. MAY 3.87. APL.21.91.
THE RELIANCE GAUGE COL. CO.
No5

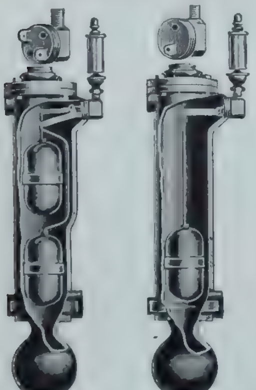
Do you think they would obey instructions? No—because if they did, it would indicate they were allowing the water level to fluctuate. The Reliance Safety Water Column compels watchfulness of the firemen to keep the whistle from shrieking, as it is as certain to blow when an improper water level exists as it is to remain silent while the water is at its proper level. These are the reasons of there being more than 70,000

Reliance Safety Water Columns

in use to-day. They do the work perfectly—day and night—whenever boilers work, and they never fail in their duty. They operate automatically, require no attention and always give a distinct alarm whenever the water falls below or rises above its proper level. They absolutely compel the water to be carried constantly at its economical point. Thus they eliminate the waste of fuel, reduced steaming capacity and danger to the engine which always accompanies an over-fed boiler, besides creating steady power and a degree of safety from explosions due to low water which, in itself, is or should be, of utmost importance to you. The Reliance Column meets every requirement of every State low water alarm law. Mechanically it is superior to any similar appliance. The valves, as you will see by referring to illustrations, are placed high above the high-water mark, and they cannot become clogged or get out of order. Every other detail of construction is based on years of constant use and actual experience, with the result that the Reliance is to-day the only permanently successful Water Column, and has been adopted as a standard part of boiler equipment by the best-known boiler manufacturers.

If your boilers are not equipped with this indispensable safeguard and economy device, write us and we'll make you our offer. You'll like it. Write for our catalogue, anyway; you'll be interested in all it says.

SHOWING ARRANGEMENT OF FLOATS



High and Low Alarm

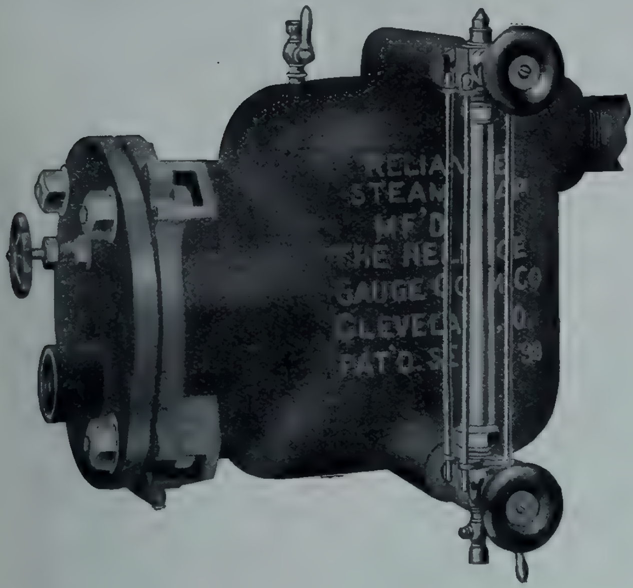
Low Alarm

The Reliance Gauge Column Co.

5902 Carnegie Ave. - Cleveland, Ohio

Also Manufacturers of the **Reliance Steam Traps, Reliance Lever Water Gauges, Reliance Lever Gauge Cocks**

The advertiser would like to know where you saw his advertisement—tell him.



You'll Finally Buy a Reliance Trap

If your experience is like that of some engineers, you'll agree, that for a small machine, the average steam trap can cause more trouble and require more tinkering and time than anything around the plant. But if you are one of the many users of Reliance Steam Traps you won't agree—

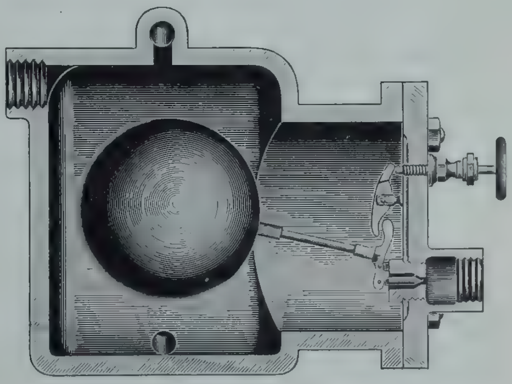
For the Reliance Steam Trap is a Strong, Sturdy, Dependable Trap

with nothing about its construction to get out of order, and so designed that it handles every drop of condensation, whether it comes in driblets or in floods. For capacity, efficiency and durability it has made for itself a reputation that means constantly increasing popularity among both present users and those who have tried others but finally bought the Reliance Trap.

That you may understand how simple and strong it is we here show two illustrations—one a sectional view, the other an exterior view. Look at them carefully. You see the valve is controlled entirely by the inflow of water; the action being governed by the quantity of condensation to be handled. This action is positive and never failing, and works equally well on both high and low pressure systems. If you want to draw out the trap or blow out the sediment, simply turn the hand-wheel and the work is immediately accomplished. If for any reason you want to inspect the trap, simply remove four small nuts and the simple internal mechanism comes out with the Cap.

The automatic action of this Trap, its simple, durable construction, freedom from wear and tear and frequent repairs, commends itself to every engineer.

We fully guarantee each Trap including the float. Write for illustrated Catalogue.



The

Reliance Gauge Column Co.

5902 Carnegie Ave. - Cleveland, Ohio

We also Manufacture the famous

Reliance Safety Water Column, Reliance Lever Water Gauge, Reliance Lever Gauge Cocks

Water Tube Boilers

Return Tubular, Horizontal Marine, Vertical and Portable Boilers, with or without Wheels

Side View of our NEW WATER TUBE BOILER. Not bricked in.

Our Engines, Boilers, Heaters, Pumps and Condensers are Prominent in Canada's Largest Power Houses.

The Goldie & McCulloch Co., Ltd.

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Ask for Catalogues, Prices and All Information.

Marine Power on the Pacific

By George Bulkeley, G. Inst. Mech. E., M.A.
Soc. Japan, Vancouver, B.C.

Canada is to have her own navy on the Atlantic and the Pacific. Trade on both coasts is increasing rapidly, and, while that on the Atlantic will be well looked after by our brethren of Montreal and the Maritime Provinces, what of the Pacific ?

There are our kinsmen in Australia and New Zealand with their produce, there is the wealth and commerce of Eastern Asia and the exchange of commodities with Japan ; and there is the practical certainty of the great westward trek of the white races completing the circuit between Canada and Siberia—via the Russian port of Vladivostock—besides all the commerce that the opening of the Panama Canal will bring to us.

It is surely no dreamer who speaks of the Pacific as an ocean highway whose trade future is every bit as rosy as was that of the Atlantic when the Cunard gave the little "Scotia" God speed, out of Liverpool.

In a recent number of Collier's, Premier McBride contributes an article in which he says that he can see in his mind's eye great wharves at Vancouver lined with freight vessels and passenger ships. He is right without a doubt, and we in British Columbia will be building those vessels on our own slipways ; it is a sign of the times already that extensive shops for the repairing of ocean going vessels are being now laid down at North Vancouver by the new firm of McDougall and Jenkins.

Marine engineering is advancing very rapidly, and the genuis of Parsons has given us the "Dreadnoughts" and the "Mauretania"; while at the other end of the scale the "black Bilbao tramp" clanks her useful way round the ports of the world—and, somewhere between the two, is the type of vessel we shall require for Canada's Pacific trade.

Besides the fleets of the C. P., the G.T.P. and the C.N. railroads, there will probably be room for a privately owned Steamship Company—financed by Canadian and British capital—whose vessels would make the round trip between Vancouver, Japan, Vladivostok, Chinese ports, Australia, New Zealand, Suva and home via Mexican ports, such vessels being of about 4,000 tons with large cargo carrying capacity, and having limited passenger accommodation at second class rates located amidships.

Question of Power.

Coming now to the question of power, there are three ways in which coal or oil fuel may be converted into useful work on the propeller shaft of an ocean going vessel ; these being :

1. Boilers and reciprocating engines.
2. Boilers and turbines.
3. Gas producers and internal combustion engines.

Since the advent of the turbine propelled battleships and of record breaking passenger liners also turbine propelled, we have somehow got to associate best marine practice with this type of engine, to forget the long service of the reciprocating engine, and one even hears it said sometimes that the latter's days are numbered in marine work.

In order to see just how matters stand for these two types of engines, the separate cases for and against them should be discussed as referring to their use for marine purposes only ; for it is obvious that many advantages which any particular type of engine may possess for land use—say in the production of electrical energy—cannot be utilized, for, and may indeed cease to be advantageous under seagoing conditions.

In hypothetical cases, taking boiler conditions as being similar—we have our high pressure steam at the throttle valve of the engines ; here at the outset the turbine has the advantage in that the energy of the steam is directly imparted to the propeller shaft without the intermission of pistons and connecting rods ; this may not seem to be a great advantage, but is considerable in the case of battleships where the height of engines has to be kept very low, thus tending towards an uneconomical reciprocating instalation, owing to short stroke and consequent high number of revolutions required to obtain efficient piston speed. On the other hand a most economical design of this engine can be used in commercial vessels where there is room for a long stroke machine ; though in directness of application the turbine has undoubtedly the best of the argument.

Following the course of the steam through the engines, some points in favor of the reciprocating machine appear in the question of clearances and of alignment. In the turbine the clearances between the moving and stationary blades, and between the ends of the moving blades and the inside of the outside casing, have to be very minute to keep leakage as small as possible; and the very careful workmanship necessary in construction, together with the possible catastrophe of their getting out of alignment and touching when under operation, does not give the impression of freedom from accident that the comparatively large clearances in the cylinder of a reciprocating engine guarantees.

In this connection it is interesting to note that the Curtis turbine is claimed to be a very rugged and simple machine, by reason of its blading being machined out of the solid ; and also that the Willans blading for the Parsons machine tends towards greater solidity by its having a strengthening band encircling the tips of the blades.

Question of Alignment.

A vertical machine is to be preferred to a horizontal one : and in this connection the distributed balance of the weights of moving parts in a multi-expansion reciprocating engine has much to recommend it over the troublesome horizontal bearings of a turbine, and by balancing on the Yarrow-Schlick-Tweedy system a wonderfully even turning movement can be obtained in the former type of ship's engines.

The economical operation of a turbine depends largely upon the obtaining of a high vacuum, and the condensing plant has to be rather more perfect than in the case of a reciprocating engine. Fortunately it is easier to obtain such a vacuum in a turbine than in the latter machine, owing to the absence of packed joints, those in a turbine being frequently steam-sealed.

Advantage of Turbine

Here is a point where the turbine especially scores in marine work, namely that by reason of the steam coming into the condenser as clean as when it left the boilers, and having no oil suspended in it, the water of condension can be directly returned to the boilers as a purely clean feed, and the scaling and pitting of shell plates then becomes merely a question of the quality of the water placed in the boilers when in port.

Disadvantage of Turbine.

A strong point against the turbine as a ship's engine is its present non-reversability ; the necessity for idle reversing turbines constantly running in a vacuum except for the short time of manoeuvring in and out of port, appears to be non-mechanical to the engineering mind, a serious addition to first cost from the commercial point of view, and a waste of space from the naval architect's standpoint.

There has been an idea that the use of turbines in marine work has at any rate meant a saving in space and weight ; as regards land work this is undoubtedly true, but on shipboard this advantage is most emphatically vetoed by the restraining influence of the dominant member of the instalation, namely the propeller.

The conditions of highest operative efficiency of a propeller and of a turbine seem, to the extent of our present knowledge, to be diametrically opposed; the former being most efficient at slow speeds of rotation and the latter at high speeds.

So that we get between the devil and the deep sea, in a very literal sense, with our marine turbine instalation; for do we seek to follow the demands of the propeller and run our shaft slowly, we have—owing to the enormous velocity of steam expanded into a vacuum—to make the operating turbine of so large a diameter that its weight becomes the same as that of a reciprocating engine of the same power ; and do we pander to the turbine and run the shalt at a high rotative speed, the pitch of the propeller must be cut down to so inefficient an extent that instead of driving a column of water aft we are merely churning up ginger beer astern.

The Solution.

The obvious solution of this difficulty would be to place a reducing gear of some sort between propeller and turbine, though marine engineers hardly fancy a clutch transmitting some thousands of horse-power in their engine room. Still such gearing-down may yet be made a practical possibility through the experiments which are being carried on by Professor Hele Shaw on large clutches, and those of Rear Admiral Melville and Messrs. Westinghouse on reducing gears.

Until something of this sort can be done, or the turbine made to run slower with equal efficiency, turbine installations on board ship must always be a compromise between propeller and turbine efficiency ; and it is characteristic of the forward policy of the British Navy that they have placed orders for two new destroyers to be fitted with Curtis marine turbines ; as it is claimed by their patentees that they can be run at a slower efficient speed than hitherto has been done in marine turbine work.

In the case of battleships, where the speed of rotation is bound to be high, the turbine is undountedly the most suitable machine for the work, but for slow speed freight vessels whose block coefficient dictates a slow turning propeller of coarse pitch, the reciprocating engine working at seventy odd revolutions seems likely to hold its own.

Marine Producer Gas Instalations.

This brings us to the important and very interesting subject of marine producer gas instalations. This branch of salt water engineering is as yet in its infancy, though the fact that so eminent a firm of ship-builders as Vickers and Maxim are known to be making a special study of the questions lays aside any doubt that the large marine gas engine is on its way to become an existing fact.

The main advantages of producer gas over steam is that the energy from the fuel is used directly in the engine without the intermediate losses accruing from the placing of a steam generator over the furnace and thereby allowing valuable energy to pass unused up the smokestack ; the losses due to condensation are also nil in a gas instalation.

The standby losses are reduced to a minimum with gas generators ; for a 1000 h.p. plant only seven to eight lbs. per hour would be burned during temporary stoppage in port, and gas could be supplied to the engines in four minutes after a night's standby.

Again the attendance is very considerably ligher than with steam boilers, and less men are required to do the work.

The main trouble with an internal combustion engine for marine purposes is, at present, the difficulty of obtaining that instantaneous reversal so important in a ship's engines. It seems, however, that this difficulty is on the fair road to be overcome by the use of the two-cycle engine running at a reasonable number of revolutions.

In such a marine gas instalation the starting ahead or astern will probably be effected either by small turbines (one for each direction) attached to the main shaft and operated by compressed air, or by ahead and astern electric motors of high starting torque attached in the same way.

In any case, whether a compressed air or an electric plant with storage arrangements will form part of the marine gas instalation : the compressor or dynamo being driven by a gas engine, and all auxiliary machinery worked by whichever power operates the starting gear—either electric or compressed air as the case may be.

The advent of a successful marine gas engine is near enough to discuss the probable mechanical arrangements which will make it conform to marine requirements. Such an engine would be vertical multi-cylindered, of the double-acting two-cycle type, having an inlet valve at each end of the cylinders and the pistons uncovering exhaust ports in the cylinder walls.

The act of shutting off the gas to stop the engine might also open both sides of the pistons in each and every cylinder to atmosphere, and allow a blast of compressed air to scavenge through them in order to clean out the cylinders from any fresh or partially compressed charges which might cause back-firing on reversal of the engine.

(This would cause uneconomical working when manoeuvring, which would be obviated when on steady running at sea.)

Two sets of cams would be provided on the cam shafts ; one set to operate the inlet valves for going ahead and the other to operate them for going astern; such cams being arranged, (either by giving them conical sides or by sliding keys), so that one set could be easily thrown out of gear and the others in to operation by similar worm and power reversing gear to that used on marine steam engines.

The operation of engaging and disengaging the two sets of cams would also throw the ahead or astern starting turbine (or motor) into action. Opening the gas valve would admit gas to the mixture chambers of which there would be one to each cylinder.

These mixture chambers would be probably constructed so as to have plungers worked off the main engine pistons, and being synchronous in action with them but opposite in effect, thus alternately drawing in a mixture of gas and air and then compressing it slighly, causing it to flow through the inlet valves of the cylinders.

The opening of the main gas valve would also close cylinders to atmosphere ; then, the main engine receiving some revolutions in the required direction from the starting engine, it would pick up the load and start off ahead or astern, the starting gear being automatically thrown out of operation.

It is an axiom that the worse the quality of a fuel for use in the furnace of a steam boiler, the greater saving which may be realized by the use of it in a producer gas generator.

Now the central coaling station for the North Pacific is Japan, and vessels trading from Vancouver to Vladivostok or Hong Kong, find it convenient to take on board a considerable quantity of Japanese coal en route.

(En passant—If any Canadian engineers are planing a trip to Japan, they will be well repayed for a visit to Nagasaki to see the big ships of the British, American, French and German Mercantile Marines coaled in that port. The work, which is done by women using flat 10 lb. baskets, is carried on with such marvellous dexterity that the port holds the world's record for speedy coaling. The whole business is an object lesson in what may be done in handling material by method and cheap labor.)

Japanese Coal.

Japanese coal of the medium and low priced kinds is notoriously poor for use under steam boilers, and the fact that every smoke stack in Japan is pouring out volumes of thick black smoke bears witness to the fact that the conditions of combustion down below are susceptible of improvement.

The writer, when working in Japan, had occasion to make an investigation into the steaming qualities of various Japanese coals with a view to eventually designing a suitable furnace and setting for general use under water-tube boilers in that country. It was found, after experiments conducted with boilers under working conditions and calorimeter tests of samples—that the poor qualities of the cheap grades of coal absolutely preclude its use under boilers without employing a grate of impracticable size; a mixture of poor dust and medium lump coal, known as "kirikomi tan," was therefore used, and it is difficult to get down below 5 to 6 lbs. per h.p. per hour with this.

The same coal used in a Mond Producer Gas generator has worked out at .79 lbs. per h.p. per hr., showing that for such poor grades of fuels the generator --by passing on all the energy given up by the fuel to the engine—is far and away more economical than a steam boiler. The results obtained on good steam coal are also about 50 per cent. better than the best marine practice.

The gas generator has already proved itself more economical than a steam generator for extracting energy from fuel, and it also occupies less space than the latter. The gas engine is a success for running in one direction of rotation, and the principal difficulty which we are up against before we can get a practical marine gas instalation is that of the prompt reversability of the engine; and this is what we have got to work at.

No large marine gas engine having as yet been constructed, the above description can only be hypothetical; the writer's idea being to bring out some points, speculative and otherwise, which appear to him to be of interest with reference to the mechanical construction, practical operation and general efficiency of various types of large marine engines.

The fact that Canada is to have her own navy is sufficient to arouse pride and interest in things nautical, and it is worthy of careful thought and consideration by our Universities as to what special course of marine engineering shall be added to existing curriculums to meet with the coming demand for men to design and operate ship's engines for and in Canada's navy and mercantile marine.

HIGH VOLTAGE TRANSMISSION.

With the purpose of studying enormously high voltages a short experimental transmission line has been built in Sweden which is adapted to operate at 500,000 volts. A special form of transformer is used to furnish this high electro-motive force. Circulating oil is used for insulation between the high and low-tension windings. The line is supported on the suspended type of insulators which are hung at a distance of 11 feet apart. Tests of the surface discharged showed that a wire of 10 square millimeters (0.0155 square inch) cross section would discharge at 35,000 volts; of 20 square millimeters at 50,000 volts, of 100 square millimeters at 200,000 volts, and of 250 square millimeters at 390,000 volts. As the tension was raised to 480,000 volts, the noise grew very loud and sparks leaped from the insulators. At night the glow of the discharge could be seen 2½ miles away.

HANDY BOOK OF INFORMATION.

Julian d'Este Co., 24 Canal Street. Boston, Mass., have issued a book for engineers, the d'Este Engineers' Manual. This contains a great deal of information of value to engineers, electricians and machinists, and is in a very convenient form to be carried in the pocket. The information is put in such a way that it can be readily understood by the readers. There are 120 pages and numerous illustrations and examples worked out, together with valuable tables both mechanical and electrical. This book will be sent to reputable engineers upon request to the Julian d'Este Co., on the firm's letter head.

SAMPSON WATER TURBINE.

The accompanying illustrations show a 62 inch water turbine to operate under a ten foot head at Peterboro. These views were taken at the works of the William Hamilton Co., Peterboro, where a pair of them were built.

Fig. 1 shows the Samson vertical runner and shaft. Fig. 2 shows a complete Samson vertical turbine with the base of the second of the pair in the foreground. These are each 245 horse power and will operate an old set of pumps that have been in service for sixteen years. The speed is 83 r.p.m. This runner is composed of two separate and distinct types of wheels, having thereby also two diameters. Each wheel or set of buckets receives its separate quantity of water from one and the same set of guides, but each set acts only once and singly upon the water used.

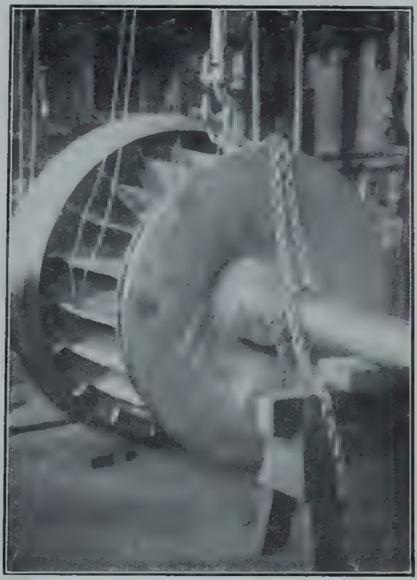


Fig. 1.—Samson Water Turbine.

Fig. 2.—Samson Water Turbine.

COST OF POWER TO PETERBORO.

The folowing table will show the rates in Peterboro from one horse power up:

From 1 to 5 h.p., $40 per year.
From 5 to 10 h.p., $30 per year.
From 10 to 15 h.p., $25 per year.
From 20 h.p. and up, $20 per year.

Course of Lessons for the Instruction of Stationary Engineers[*]

Eighth of a Series of Interesting Educative Articles — This Article Contains Theoretical and Practical Information on Safety Valves.

By W. A. CROCKETT[**]

The area of a safety-valve should be sufficient to allow the steam to escape rapidly so as to prevent the raising of steam in excess of 10 per cent. of allowed pressure and therefore calculations should be standardized from the maximum water evaporated per pound of fuel.

All the points of bearing on lever must be in the same plane.

The distance of the fulcrum must in no case be less than the diameter of the valve opening.

The length of the lever not to exceed the distance of ten times the fulcrum.

The width of the bearings of the fulcrum must not be less than ¾ in.

The length of the fulcrum link not to be less than 4 in.

The weight must be adjusted on the lever to the pressure of steam allowed, in each case by a standard steam gauge attached to boiler, weight should then be fastened securely in this position.

When safety-valve is blow-off, note the gauge pressure and see that they correspond.

The lever safety-valve cannot be said to be perfect in action or operation, because it does not seat itself until the pressure has been considerably reduced below point set at.

The following rules are genrally used as to pressure, length of lever, and weight of ball.

Blow-off Pressure.

Rule to find pressure a safety-valve will blow-off at when weigth of ball, length of lever, and distance of valve centre to fulcrum are given—

a=valve area=3 in. valve 3×3×.7854=7.068 area.
b=length of lever 3×10=30 in.
c=weight of lever=20 lbs.
d=distance from fulcrum to centre of valve in inches=4 in.
e=weight of ball=150 lbs.
p=pressure=160 lbs.

$$\text{Then } \frac{e\times b+c}{a\times d}=p=\frac{150\times30+20}{7.068\times4}=$$

159.87 or 160 lbs. nearly.

Length of Lever.

Rule to find length of lever when p, e and a are given:

$$\frac{a\times p\times d+c}{e}=p$$

$$\frac{7.068\times160\times4+20}{150}=30\text{ in.}=\text{length of lever.}$$

Weight of Ball.

Rule to find e when p, d and a are known.

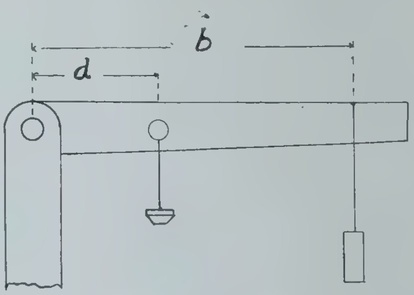
$$\frac{p\ (a\times d)-c}{b}=e$$

$$\frac{160\times7.068\times4-20}{30}=150\text{ lbs.}$$

Good Rules.

Suppose that a 3 in. safety valve has been set to blow off at 100 lbs. per sq. inch, but does not do so when the steam gauge shows 100. To find whether the lever is graduated corectly. Get the valve and cover and bolt the cover to a couple of 4-in. x 4-in. x 4 ft., block the timbers up sufficiently high to allow a platform scale to go under them. So that while the valve rests upon the scale the lever will be horizontal. When this is done put the weight at the 100 lb. notch. The valve diameter being 3 in. its area will be 3×3×.7854=7.068.

The total steam pressure necessary to raise the valve when weight is at 100 lb. notch is 7.068×100=706.86 lbs. If scale balances at this point the lever is correctly graduated. If not balance it and this will be the correct point.



Safety Valve Lever.

Safety valves should be placed in direct connection with the boiler. Under no circumstances should a stop valve be placed between the boiler and safety valve. The safety valve must be free to act and to prevent it from corroding fast to its seat it should be raised from its seat occasionally. I heard of a place where the safety valve was so corroded and frozen that after an explosion causing some $50,000 damage had occurred, it took 4 blows from a 4 lb. hammer to release it.

A LARGE LEATHER BELT.

The largest and most expensive leather belt for power drive ever made was recently shipped by the Charles A. Schieren Co., 37 Ferry Street, New York, to the Great South Lumber Co., Bogolusa, La. The belt is a Duxbak waterproof, and it is 243 ft. long, 6 ft. wide and three-ply thick. The hides of 540 steers were utilized to make the belt and it was tanned in the Bristol, Tenn., plant of the Charles A. Schieren Co., and finished in the New York plant. The belt will be called upon to deliver between 1,600 and 1,700 h.p.

As the purchaser was in urgent need of additional power equipment, directions were given that the shipment be made by express, and this resulted in the payment of the largest express charge on a single belt on record. The belt cost more than $5,800 and the expressage amounted to exactly $243.07. This belt, the Charles A. Schieren Co. claims, is absolutely waterproof and, as it is to be used in an extremely swampy section of the lumber producing district of Louisiana, leather belting people will watch with interest the service it gives.

COST OF POWER IN LINDSAY.

The following rates were in force in Lindsay previous to July 1909:

One and two h.p., $45 per year.
Three h.p., $40 per year.
Five h.p., $35 per year.
Ten h.p., $30 per year.

These prices have been reduced since July 1st to $30 per year. The present rate per year for motors over 10 h.p. is $20. The Lindsay Light, Heat & Power Co., make a net rate of $17.50 to concerns using 20 h.p. or over.

In winter, if the boiler is exposed to cold, close the valves between the boiler and the water-gage glass when the boiler is shut down for the night, and let the water run out of the glass. Also leave all drain cocks on pipes, etc., open.

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[*] The seventh article appeared in June 1909. Readers will, we are sure, appreciate the re-appearance of Mr. Crockett's articles.

[**] Executive secretary C.A.S.E.

Setting the Valves of the Leonard Corliss Engine[*]

Sixth Article of a Series on Setting the Valves of Canadian Engines—This one Deals with Single Eccentric Type Corliss Engine of E. Leonard & Sons, London, Making Proper Adjustments of Valve Gear and Governor.

The Corliss engine is well known to engineers. This type of engine has become the recognized standard in the engineering world, it being in a class by itself for durability and economy.

The Leonard Corliss is manufactured by E. Leonard & Sons, London, their patterns embracing a range from 50 h.p. to 2,000 h.p. in standard girder or heavy duty frame types.

The following are instructions for adjustment of the valve gear of engines of the single eccentric type.

Steam and Exchange Valve.

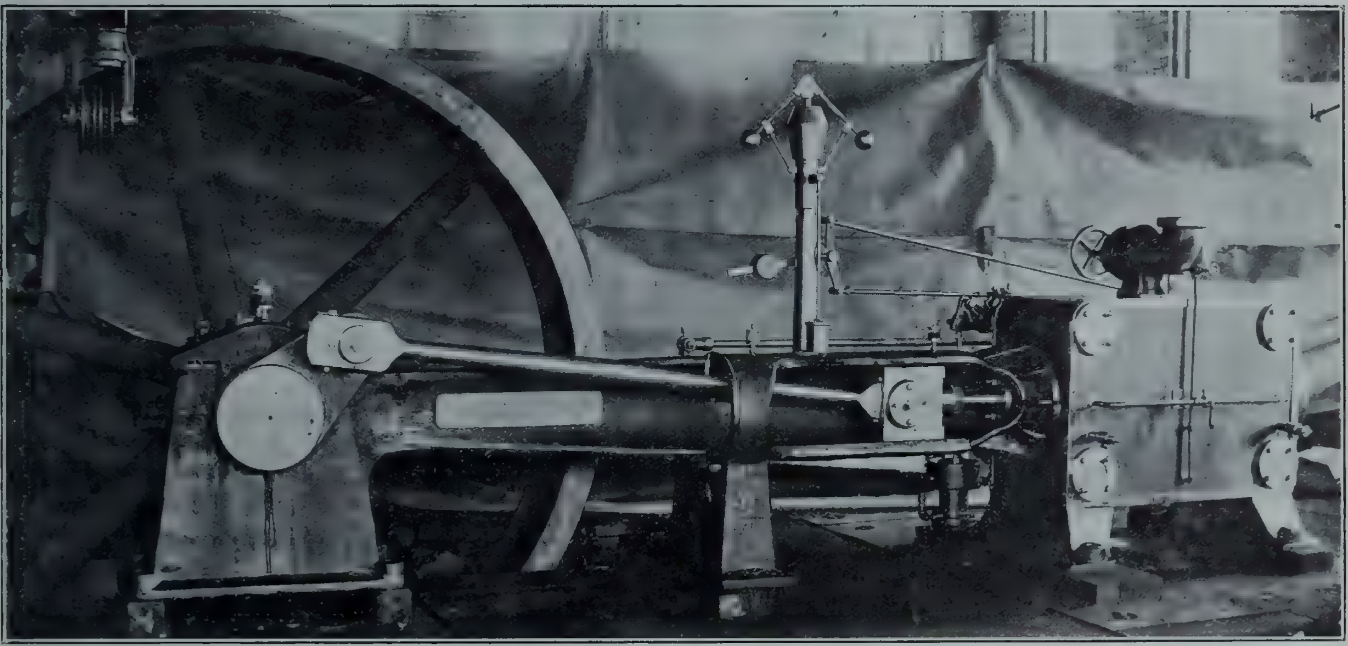
Take off the back valve cover or bonnets and upon the end of the bore of the seats you will find a mark which is in line with or coincides with the closing edges of the ports for that particular valve seat. Look upon the end of the valve and find a mark running towards the centre of valve, this line coincides with the closing edges of valve. Note that in case of the exhaust valve, the valve controls the ports leading into the exhaust passage and not the opening from the cylinder downward. On all engines, the edges of the steam ports nearest the centre of the cylinder are the closing edges. On all 24 inch stroke engines the edges of the exhaust ports farthest from the centre of the cylinder are the closing edges. On all larger engines the edges of the exhaust ports nearest the centre of the cylinder are the closing edges.

Wrist Plate.

The wrist plates should now be looked over, and a mark will be found upon the hub of the same, and corresponding marks upon the hub of the wrist plate bracket. Also marks which show the full extent of motion of the wrist plate when it is moved back and forth by the eccentric. The wrist plate should be located on the vertical centre line of the cylinder, and is so placed in the shop in building the machine, and all adjustments are made and valves properly set, but in taking apart for adjustment it may be possible that the adjustment may be disturbed and need careful going over before attempting to start the engine for the first time.

To Test Marks on Wrist Plate Hub.

Connect the eccentric rods and engage or lock the reach rod upon the wrist plate stud; then rotate the eccentric upon the shaft the full extent of its throw or movement each way, and observe if the marks upon the hub of wrist plate at full throw agree with the marks upon the bracket; if not, adjust the screw on stub end by lengthening or shortening the reach rod as required, until the marks do agree on both extremes of movement. Now you are ready.



Crank Side Leonard Corliss Standard Engine.

To Set Valves.

To set valves place the wrist plate in a vertical position (at the central mark on bracket), turn the valves around in their seats until the steam valves show by the closing edge, marks upon their ends by comparison with the port line marks in the seats that the steam valve edges lap over or cover the ports 3-16 of an inch for 12 inch bore of engine cylinder, ¼ for 16 inch cylinder, and ⅜ for 20 inch cylinder. The exhaust valves should show the valve to be line and line with the ports in the cylinder.

Connecting Wrist Plate

See first that the pick-up hook is hooked on the stud or square steel block in steam lever, or is engaged. Leave the wrist plate and valves in their positions and adjust the length of the wrist plate rods to suit the distances between the studs, or, in other words, connect the wrist plate and steam and exhaust valve arms so the wrist plate stands at the central mark or vertical, and the steam and exhaust valve have the proper lap and line as instructed, the proper amount of steam lap being determined as above by the size of the engine.

To Make Final Adjustments.

Now with the reach rod hooked upon the wrist plate stud, place the engine upon the centre, knowing which way the engine shaft is to run, turn the steam eccentric upon the shaft (it being loose) in the same direction in which the shaft is going to run until the steam valve at the same end as the piston then stands is open, say 1-16 of an inch ; in this position secure the eccentric on the shaft by means of the set screws in the hub, see in all cases that the steam valves are hooked up or engaged by the cut-off mechanism then turn the engine on the opposite centre and see if the steam valve on that end has the same amount of opening ; if not, you can make the adjustment by lengthening or shortening the wrist plate rod attached to this valve.

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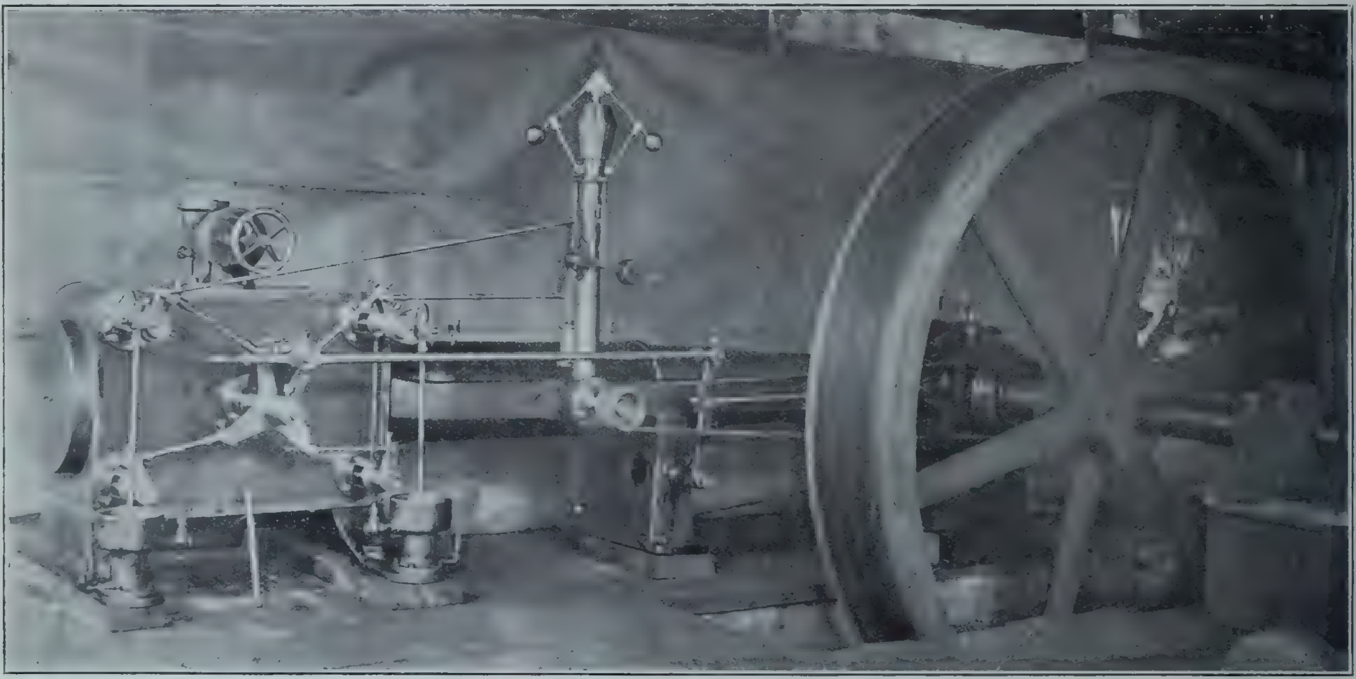
[*] First article appeared in April, second in May, third in July, fourth in October and fifth in November 1909.

To Adjust Cut-off.

To adjust cut-off see that the governor and connections are put together properly and block the governor about half way in the slot ; then fasten the governor or cam rod lever so it stands about at right angles to a line drawn midway between the governor rods ; then lengthen or shorten the governor or cam rods until the cam or trip levers stand vertical or plumb. The governor and connections now occupy the proper relative positions, and it remains to make the exact adjustment of governor.



Balance Wheel Side of Leonard Corliss Standard Engine

Exact Adjustment of Governor.

And to equalize the cut-off so that the same amount of steam is admitted at each end of the stroke, to do this, lower the governor and observe when the governor is down on the top of the automatic stop at the side of governor column, that the cut-off mechanism does not unhook, but allows steam to be taken full stroke—(right here we would say that it does not appear to be generally known that the Corliss valve motion when properly made is provided with a positive closing device which, in case the valve does not trip, positively closes the valve before piston reaches the end of the stroke)—after which place the engine at, say ¼ of the stroke, which can be done by measuring upon the engine bed guides from each end of the stroke and turning the engine (with all parts connected up) until crosshead is fair with the mark, then slowly raise the governor until the cut-off on the end taking steam trips or unhooks, and to ensure this point being accurately determined, it is well to stand by with the hand pressing down upon the dash-pot rod ; now block the governor in this piston and try the cut-off on the other stroke same distance from the end. After a few trials back and forth, and adjusting the length of the cam rods, the cut-off can be made to drop at precisely the same point of stroke. Take care to secure everything permanently when done.

Note, on Automatic Safety Attachment.—As all Leonard engines are fitted with safety automatic cams, designed to act only when governor has fallen to bottom of slot in the governor column, before finishing your adjustment see that when the governor is at its proper height in the slot for the speed at which the engine is set to run, it will trip the cut-off at any point between the lead position and 1-3 stroke, then when resting on the top of the safety stop on governor column, the valve gear will follow full stroke and when safety stop has turned down, the governor will drop low enough to allow the safety cams or knock-off levers to be brought into play so as not to permit the steam valves to be opened, the safety cams preventing the pick-up hooks engaging with square steel studs in the steam valve levers.

Dash-pot Rod.

The dash-pot rod should be adjusted in length so that steam valve lever or arm resting thereon, when the dash-pot plunger is home, or at the bottom of the pot is in such a position that the latch or pickup hook is sure to hook over the latch stud or steel block. In this position the bell crank connecting the valve with the wrist plate is at its extreme travel at the end ready to open the valve to admit steam to the cylinder. This will ensure on the one hand the positive engagement of the latch, and on the other hand prevent the shoulder from jamming down upon the latch stud. If the dash-pot is too short. the latch will not hook on. Look out for this.

To Adjust Vacuum Dash-pots.

The steam valves are closed by vacuum pots of improved design. When steam valve is opening the dash-pot rises and a strong vacuum is formed in the lower chamber. When the valve is released the vacuum in the lower chamber of dash-pot draws the plunger rapidly to its seat, the air below the cushioning piston in the upper chamber flows out through the valve at the side of cushioning chambers. The action of the dashpot is controlled by the check valve on one side of vacuum chamber and valve on side of cushioning chamber. If vacuum is too strong and the plunger pounds when the valve on side of cushion chamber is closed, open

(Continued on page 35).

Opening in Canada for Refrigeration and Cold Storage

By E. J. Greenstreet, F.R.A.I.C,*

It is impossible to cover, within the limits of a newspaper article, the many and various purposes to which refrigeration is applied in connection with commercial undertakings. I intend to give however, for the benefit of the numerous readers of The Power House, a brief outline of some of the more important applications of refrigeration and cold storage to the different branches of trade and commerce throughout the Dominion. I shall also endeavor to show as concisely as possible, the extent to which some industries are dependent upon this particular branch of science, and the absolute necessity if certain lines of business are to be conducted successfully, of some method of refrigeration and cold storage.

In no direction is this need more clearly shown than in connection with the various food stuffs of the country. It is safe to say that there are few instances where the principal lines of perishable produce can be handled, transported and marketed on a large scale without the aid of mechanical refrigeration in some of its modern forms of application.

Take first of all some of the principal articles of food, such as meat, butter, eggs, fruit, poultry and fish. It will be interesting to examine the extent to which a certain temperature, sometimes within very narrow limits, is absolutely essential in handling successfully and storing for lengthy periods these various articles of daily consumption. I think it will also prove instructive to show the part played by refrigeration in maintaining these requisite temperatures, regardless of what nature herself may be doing at the moment, in that particular direction.

British Imports.

The meat eating Briton in all probability, does not stop to consider the extent to which he is indebted to mechanical refrigeration for his mutton chop or beefsteak. During the ten months ending the 31st of October, 1909, Great Britain imported from over seas 1,047,563,888 lbs. of dead meat (578,771,648 lbs. of beef and 468,792,240 lbs. of mutton). The greater portion of this enormous total was shipped in a hard frozen state, but some of the beef was carried in a chilled condition; that is at a temperature above its freezing point. As not a single pound of this meat could have been handled, transported and marketeted without the aid of refrigeration it will be interesting to examine the methods by which this result has been achieved, and this immense business built up.

Methods Used in Shipping.

The cattle and sheep are killed as near their own pastures as possible and the carcasses (unless the atmospheric conditions are favorable for natural precooling) pass at once to the refrigerating chambers where they are frozen at a temperature between 5 and 10 degrees F. The hard frozen carcasses are held at a temperature of about 15 degrees from the time they are frozen in the various works in the antipodes, and in the Argentine, until they are thawed out for the consumer in Great Britain.

In the early days of this trade all the refrigerating machinery employed was of the type known as "Cold Air" machines, that is the refrigeration was affected by the compression, cooling and subsequent expansion of the natural atmosphere, which was discharged, directly into, and circulated through the freezing chambers, cold stores, or holds of the vessels carrying frozen meat. Of late years, however, refrigerating machinery operated on the ammonia compression, or CO_2 Systems. has entirely supplanted the cold air machines on land, and has also largely displaced that type of machinery on the sea. Chilled beef, large quantities of which are sent to Great Britain, principally from the United States and the Argentine, needs to be handled in a totally different manner. In the case of hard frozen meat, the proposition from a refrigerating point of view, after once the meat is thoroughly frozen, is comparatively simple. Within certain limits, any temperature well below the freezing point of meat, will maintain it in perfect condition for lengthy periods; and although I have mentioned 15 degrees F., as a suitable temperature, a range of temperature, say between 10 degrees F. and 18 or 20 degrees F., makes but little difference to its keeping qualities. With chilled meat, however, it is quite another story, and for long storage the temperature has to be caintained with as little range as possible, a variation of even 1 degree having some influence upon its keeping qualities. The freezing point of beef, that is the temperature at which the liquids are completely changed to solids, is between 28 and 29 degrees F. It has been found that a temperature slightly above this, say 30 degrees F. or there abouts, is the best and most satisfactory for the storage and carriage of chilled beef. This temperature must be maintained as steadily and with as little variation as possible, and even with such precautions the length of time during which chilled beef can be held in perfect condition is only about 6 weeks. Experiments, however, are now being conducted in the carriage of chilled beef from Australia by a system known as the "Linley Process," by which it is claimel that meat in a chilled state can be kept for 80 or 90 days, thus affording ample time for transporting from the Antipodes.

Linley System.

The "Linley" system which is used in conjunction with refrigeration, and is not in any way intended to take the place of cold storage; consists in a method of sterilizing cold storage rooms, and the refrigerated holds of vessels containing the chilled beef, in such a manner that all bacteria and fungoid growths are destroyed, and their re-appearance prevented. This is accomplished by circulating through the chambers small quantities of formaldehyde gas, also by cleansing and purifying at intervals the air of the rooms, and regulating the humidity of same.

The first consignment of chilled beef conveyed by this system was placed upon the London market last month, after being 70 days in transit from Australia. I understand that it arrived in excellent condition, and if such is the case, no small result has been achieved, for all experiments in this particular direction have hitherto proved failures. This success shows a distinct advance in cold storage methods and indicates the great value, in the case of delicate produce, of a proper system of sterilization and some method of ventilation; as well as the necessity of regulating the degree of humidity in cold stores.

As I am now in communication with Mr. Linley himself regarding his method, and its introduction into Canada, I shall be in a position to give full and more complete details very shortly, as to the suitability of the process for handling Canadian produce. I may mention that in Mr. Linley's opinion it could be applied with advantage to the cold storage of apples, fish, etc.

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* Cold Storage Architect and Refrigeration Expert, 32 Adelaide St. E., Toronto.

Canada's Opportunity.

Up to the present time Canada has done nothing in the way of developing an export trade in chilled meat, but that business is likely to be taken up very shortly, and a movement is already on foot in Western Canada to make a commencement by initiating an export trade in chilled meats and packing house products from the three prairie provinces. There is no real difficulty in carrying chilled beef from the west. and landing same in perfect condition on Smithfield market, and there are no problems in refrigeration in connection with the undertaking that have not already been solved and tested. The immense benefit to Canada of having, in addition to her own local market, such a valuable outlet as the principal meat market of the world, can hardly be over-estimated.

Before leaving the subject of meat and dealing with the cold storage of other lines of produce, it may not be out of place to touch upon the great necessity of some means of refrigeration during the summer months for handling meats of all kinds in the various towns and villages throughout the Dominion. This need is felt, I think, by all butchers and dealers, who handle meat during the hot weather. The actual loss is sometimes very considerable, and the loss by deterioration and the serious falling off in quality, is impossible to estimate. Of course, all large packing houses use mechanical refrigeration, indeed it would be impossible to conduct such businesses without. Many of the smaller men use some form of ordinary cooling by natural ice, perhaps the most primitive form of cold storage in existence. Considering that it is now possible to instal refrigerating plants of greatly improved kinds, very much more economically than formally, it can only be assumed that many people are unaware of the recent improvements in refrigeration, and have no knowledge of the comparative cheapness of instalation, and simplicity of operation of some of the modern systems.

Cold Storage for Eggs.

One of the most important applications of refrigeration in the United States and in Canada, is in connection with the cold storage of eggs. By some the term "Cold Storage Egg" is used in the most disrespectful way, and in a manner anything but flattering to that method of preservation. The fact remains, however, that cold storage has superseded all other methods for handling and storing eggs; and given proper conditions of storage such as correct temperatures steadily maintained, air circulation, ventilation, and the proper degrees of humidity, eggs can be held in cold storage for 9 months or so in perfect condition. There is one other point, however, frequently neglected. If eggs are to come out in first-class condition they must be in first class shape when placed in storage. This appears so self evident as to be hardly worth mentioning, but I believe neglect of this precaution must share with imperfect cold storage arrangements the responsibility for the term "Cold Storage Egg" sometimes employed in an opprobrious way. There is considerable difference of opinion as to the proper temperature for the storage of eggs, but 30 degrees F. evenly maintained throughout the room, properly arranged air circulation, some system of ventilation, and between 70 to 80 per cent. humidity gives excellent results.

Other Applications.

To deal next with the applications of refrigeration to the handling of milk, butter, cheese, etc., it is safe to say that the many and important industries connected with the various kinds of dairy produce, could not be conducted successfully without the aid of refrigeration. From the time the milk is first handled until the final production of the butter or cheese, refrigeration in some form or other must be used, whether it is applied in the simple form of ice or cold water furnished by nature, or by means of mechanical refrigeration in some of its numerous applications. Refrigeration is equally necessary for the handling and storing of the finished article. In recent years a change of opinion has occurred as to the best temperatures for the long storage of butter. In the early days of the frozen meat trade from New Zealand, the writer had personal experience with shipments of butter, which were sent to the English market and kept during transit at a temperature of 40 degrees F. Now the general practice is to keep butter for long storage at a temperature of about 15 degrees F., the same temperature at which frozen meat is carried. Some authorities favor even a lower temperature than this, and maintain that temperatures round about zero will preserve the flavor more perfectly. Personally I am of opinion that in the case of temperatures well below the freezing point of water, a range of 5 degrees F. will make but little difference, and I doubt very much whether even butter experts could tell the difference in butter held for six months at a temperature of 15 degrees F. and butter stored the same length of time at a temperature of 20 degrees F.

Much could be said about the "Cold Storage" and "Cold Curing" of cheese and the applications of refrigeration in connection with same. I will, however, leave this section of my subject with a reference to the work done by the Dominion Government, and by some of the Provincial Governments, in encouraging the use of refrigeration and cold storage, as applied to the dairy industry, and in making known the various benefits as well as the simpliest and best systems to adopt. Mr. Ruddick, the Dairy and Cold Storage Commissioner, at Ottawa, has shown a keen appreciation of the manifold advantages, and has pointed out the absolute necessity, of cold storage and refrigeration as applied to creameries, etc. Anybody interested in this question, can obtain for the asking, a phamphlet on "Creamery Co'd Storage," by J. A. Ruddick, and may also gather much valuable information on the subject from the dairy and cold storage commissioner's reports and other literature issued from that branch of the Department of Agriculture.

Refrigeration and cold storage for fish and fruit, require very different applications, and the arrangements necessary for dealing with these two important food products stand at the two extremes as regards the temperatures necessary. The same machinery will do the work, but the methods by which the cold is applied (or to be more exact the heat extracted) are very different. In the case of fish the bst practic to-day consists in sharp and quick freezing at low temperatures. Fish should be frozen as soon as possible after coming out of the water. After freezing, some kinds of fish are dipped in cold water thus forming a thing coating of ice. They are then held in cold storage ready for transportion to the large centres of population. By an intelligent application of refrigeration and cold storage, it is now possible to freeze, store and market in splendid condition in almost any large centre, the immense quantities of fish to be obtained off our shores, both east and west, and abounding in our great lakes. There is much to be done in Canada in this direction, and in my opinion refrigeration is destined to do a great deal in handling one of our most valuable articles of food, and assisting to develop one of Canada's most important industries.

With regard to apples and various other fruits, the field for refrigeration has hardly been touched. The wastage in the fruit business all over the fruit producing areas of Canada is enormous, and vast quantities of fruit, representing considerable wealth that should be utilized, are never properly marketed, owing to the need of cold storage and facilities in the way of refrigerator cars. As soon as fruit growers and shippers realize that refrigerating machinery can be economically installed for the storage of apples, etc., they will certainly take advantage of a more up-to-date and scientific way of handling their produce.

I have dealt with some of the principal lines of produce, and have endeavored to show the necessity of some form of regrigeration for storing, transporting and marketing. If the produce people of Canada have perhaps been slow to take full advantage of the modern improvements and applications of refrigeration, there are compensating advantages. Not the least of these being that they are now in a position to adopt those methods which experience has shown to be the best and most suitable.

There are quite a number of other uses to which refrigeration and cold storage can be put. In brewery work refrigeration is absolutely necessary. In the manufacture of artificial ice, refrigerating machinery will certainly be widely used in many parts of Canada, as offering certain advantages in producing an absolutely pure article, in some cases at a less cost than nature can do the work; or rather at a less cost than the natural article can be harvested, stored, transported, handled and delivered. Refrigeration is widely used for the storage of furs and dried fruits, and is also applied in various ways in connection with hotels, apartment houses, rinks, chocolate factories, hospitals, powder factories, morgues, etc.

WATER CONTAMINATION.

Would water be contaminated if pumped from a well within 110 ft. of a septic tank?

B. C. READER.

Under ordinary circumstances 110 ft. would not allow contamination, but it would depend on the nature of the soil and the strata. If it is gravel it would be a risky proposition. An engineer would require to examine the soil before deciding whether the well would be contaminated.—Editor.

Edward M. Merrill, consulting engineer, has moved his offices from the Lawlor Bldg., to the Toronto General Trust Company's building, Yonge St., Toronto.

What Canadians are Doing for Abatement of Smoke*

A Number of Canadian Cities Have Passed By-laws, Several of Which are Given Herewith, With Comments on Smoke Abatement.

Increasing attention is being given in Canada to the question of smoke abatement. The fact that sunshine lessens as population becomes more dense, and especially when the activity of industrial centres expands superficially and increases in intensity, has long been noted. An increasing tendency to fog has also been observed, and both are effects of the imperfect and incomplete combustion of coal. Modern industry pays toll for this in the injury to delicate fabrics, the general depreciation in the value of many articles of trade and household use, and the increased cost of cleansing. Since the battle is waged with growing energy against tuberculosis, physicians and students of social science feel that the problem of purer air for the dwellers in cities has become one of prime importance.

Statistics have been collected for some time past by other countries which demonstrate how little sunshine falls to the lot of the residents of industrial cities, even when the sun is unobscured by smoke particles. Canada is beginning in the right direction by making and enforcing proper smoke abatement legislation. It then rests with engineers and manufacturers to keep informed on the most up-to-date equipment and methods to secure smoke abatement or else pay the penalties of the law.

Succeeding issues will contain methods of smoke elimination. These will deal with boilers, draft and other elements entering into the question of smoke prevention.

Brantford's By-law.

On June 12, 1905 Brantford enacted the following by-law for the prevention of the nuisance arising from smoke:

1. All manufacturers and others within the city of Brantford shall provide such chimneys or other apparatus as shall consume the smoke from their works, factories, mills or shops, or shall prevent the same from fouling the atmosphere, or from being carried by the wind or otherwise to other shops, houses or premises, to the inconvenience or injury of the neighboring premises or residents therein.

2. Any person, firm or corporation who shall commit any breach of any of the provisions of this by-law shall be liable, upon conviction thereof before the Police Magistrate of the City of Brantford or any other Court having jurisdiction in the premises, to a fine not exceeding fifty dollars and not less than twenty dollars, exclusive of costs, which shall be recoverable by distress and sale of goods and chattels of the offender, and in case of nonpayment of such fine and costs (if any), and there being no distress found out which such fine, and costs (if any), can be levied, to imprisonment in the Common Caol of the County of Brant, for a period not exceeding twenty-one days, unless the fine inflicted and costs (if any), including the costs of the distress and of the committal and conveyance of the offender to Gaol, are sooner paid.

Hamilton's By-law.

On Feb. 22, 1909, Hamilton passed the following by-law to compel the prevention of smoke. It is modelled on that of Toronto.

1. No owner, lessee, tenant, agent, manager or occupant of any premises or steam engine in which a fire is burned and no person who operates, uses or causes or permits to be used, any furnace or fire within the limits of the City of Hamilton, shall permit the emission to the atmosphere from such fire, of opaque or dense smoke for a period of more than six minutes in any one hour. The point at which such emission shall be determined shall be that point at which the smoke is discharged from the opening, flue, stack or chimney to the atmosphere. Nothing herein contained shall reply to any furnace or fire used in connection with the reduction, refining or smelting of ores or minerals, or the manufacture of cement, or private dwelling houses, except they be apartment houses of a greater height than three storeys and basement.

2. No prosecutioo shall be commenced under this By-law until at least ninety days' notice in writing has been given by the City to the person to be proceeded against of the existence of the By-law.

3. Any person convicted of a breach of any of the provisions of this By-law shall forfeit and pay, at the discretion of the convicting magistrate, a penalty not exceeding (exclusive of costs) the sum of fifty dollars for each offence, and in default of payment of the said penalty and costs forthwith, the said penalty and costs, or costs only, may be levied by distress and sale of goods and chattels of the offender, and in case of there being no distress found out of which such penalty can be levied, the convicting magistrate may commit the offender to the common gaol of the City of Hamilton with or without hard labor, for any period not exceeding six calendar months, unless the said penalty and costs (if any), including the costs of the said distress and of the committal and conveyance of the offender to the said gaol, are sooner paid.

Ottawa and Toronto.

Ottawa's by-law passed on July 1908 is practically the same as that of Hamilton as is also Toronto's. These laws show that the engineer or firemen may be proceeded against as they are the men responsible for the conduct of the fire.

They also permit justice being done to the proprietor. If he provides the means whereby smoke may be confined within reasonable limits, it is not fair that he should be prosecuted for the delinquency of employes. It will be noticed further that this law designates the emission of dense or opaque smoke to be in contravention of its terms. There can be no quibble as to what constitutes the dense or opaque, as the words have a well defined meaning in practice and law. The location at which the character of such emission shall be determined is also nominated, viz., the point at which the smoke is discharged from the opening, flue, stock or chimney, to the atmosphere. It will also be noticed that prosecution may not be commenced until at least ninety days' notice in writing of the existence of the by-law, has been given by the city to the person proceeded against. This gives opportunity for the offender to furnish bona fides of his intention to remedy conditions.

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* This is the first of a series of articles on Smoke Abatement. This article contains regulations of certain Canadian cities. In succeeding articles, information will be given on "How to Secure the Smokeless Combustion of Coal."

Winnipeg.

Winnipeg by-law is to control the emission of smoke from chimneys and manufactories and other buildings to the inconvenience and injury of citizens. It is as follows :—

1. The owners and persons in charge or control of manufactories, stationary engines or boilers, shall have such chimneys or other apparatus as shall consume the smoke thereof or prevent the same from fouling the atmosphere or being carried by the wind or otherwise to other shops, houses or premises to the inconvenience or injury of the citizens.

2. The emission of dense black or grey smoke from any chimney or smoke stack used in connection with any manufactory, stationary engine or boiler, within the limits of the City of Winnipeg, in any apartment house, office building, hotel, theatre, place of public entertainment, school building, institution or any other structure within the said City, or in any other building used as a factory or for any purpose of trade or for any other purpose whatever shall be deemed, and is hereby declared to be a public nuisance.

3. The owner, tenant, lessee and occupant of any building or structure of any description, from the smoke stack or chimney of which there shall issue or be emitted smoke, fouling the atmosphere or carried by the wind to other shops, houses or premises, to the inconvenience or injury of the citizens within the limits of the City of Winnipeg, and the Engineer or Fireman having charge of or operating any stationary engine or boiler, in any such building or structure within the limits of the said City, from the chimney connected with which there shall issue or be emitted such smoke as aforesaid, shall be deemed and held to be guilty of creating a public nuisance and of violating the provisions of this By-law.

4. Any person found guilty of an infraction of any of the provisions of this By-law shall be subject to the penalties imposed by By-law No. 1630, of the City of Winnipeg.

Quebec.

It is ordained and enacted by the City of Quebec as follows :

1. Shall be declared to be a nuisance the dense black smoke emitted by chimneys of factories, industrial establishments, workshops, manufactories, furnaces, or by the smoke stacks of railway locomotives, steam engines, or boilers, in the city of Quebec.

2. Whoever employs such chimney, pipe or engine, is forbidden to allow such smoke to be emitted during more than six minutes in the course of each hour.

3. The fact of allowing, or causing such emission of smoke for more than six minutes in the interval of an hour constitutes an offence each hour during which such smoke shall have been emitted for the space of more than six minutes.

4. Whoever is found guilty of infringing the present by-law is liable to a fine not exceeding forty dollars, and in default of payment of such fine and costs, to imprisonment for a space of time not exceeding two months.

5. Before proceedings are instituted against any offender against this by-law, the City Engineer shall notify him to the effect that, after the expiration of three months from the date of such notice, legal action will be taken.

Smoke From Locomotives.

On Jan. 1, 1909, the Railway Commission's regulations came into effect. These are as follows :

1. Every locomotive steam engine operated in the Province of Ontario by any railway company, subject to the legislative authority of the Parliament of Canada, shall be equipped so as to prevent the unnecessary and unreasonable emission therefrom to the atmosphere of dense or opaque smoke, and every such locomotive steam engine shall, subject to clauses 2, 3, 4 and 5, while passing through or being operated within any city, town or village, be so ouerated as not to permit the unnecessary and unreasonable emission to the atmosphere of dense or opaque smoke.

2. Where it is necessary to clean out the fire box or build a new fire, the necessary and reasonable emission of dense or opaque smoke within any city, town or village may be permitted for a period not to exceed six minutes in any one hour.

3. The necessary and reasonable emission of dense or opaque smoke from a locomotive steam engine, standing at stations or in station yards, in cities, towns or villages, may be permitted for a period of one minute in any ten minutes of any one hour.

4. This Order shall apply to and be in force only in such cities, towns and villages in Ontario that have passed, or may hereafter pass by-laws for the control, regulation or prohibition of dense or opaque smoke from stationary steam engines, or a by-law or by-laws to the like effect.

5. In the ascent of the Scarboro grade easterly out of Toronto, or the grade east and west out of Hamilton, the necessary and reasonable emission of dense or opaque smoke may be permitted for a period not to exceed ten minutes in any one hout.

6. Every Company or person offending against the foregoing regulations or any of them shall be subject to a penalty of twenty-five dollars for every such offence.

This gives an idea of the smoke nuisance as seen from the various council chambers and by the public generally. Not only should the engineer seek to observe these regulations in order to escape the penalties, but he should, for the sake of economy in the plant under his charge, endeavor to eliminate as far as possible, the waste of fuel by smoke. That this can be done by exercising a little care, is demonstrated daily. In succeeding issues of The Power House, it will be shown how compliance with these by-laws may be easily made.

POWER ECONOMY CO.

This company has opened an office at 9 St. Nicholas St., Montreal and will deal in fuel saving specialties for power plants. They are manufacturing and putting on the market a new line of metallic packing called the "F. & W." Metallic Packing for steam, air, water and ammonia. The trade phrase under which this packing is sold is "The kind you put in and forget." The packing is adapted to superheated steam as the metal used admits of very high temperature. The only other constituent of the packing is wired asbestos which, of course, is impervious to heat. The company claim to have a packing which will be as inexpensive as any first class brand of rubber and asbestos constructed packing and one that will not injure the rod in any way.

This firm has purchased the sole Canadian rights to the Crescent Grate Bar, a recent invention of a Montreal engineer. This bar is already doing efficient and economical service for such firms as the Laing Packing Co., Henry Birks & Sons, Mark Fisher Bldg., Stonewall Jackson Cigar Factory.

The main feature of this grate bar is the crescent shaped opening from which the name is derived. These openings give a maximum draft area with minimum amount of metal and is claimed to be superior to the herring-bone style in that there are no points or metal bridges to burn off.

In connection with the grate bar the Power Economy Co. will sell the Tornado Steam Blower, Patented, for which they have the sole Canadian agency. The combination of the grate and blower is claimed to give a very high efficiency in burning the cheapest sort of fuels, such as anthracite birdseye, bituminous slack, screenings, duff, etc. The grates are so fashioned as to form when in place a reservoir, as it were, in which the draft air is held in passing and heated before striking the fire.

Among the other lines carried will be Tenax sheet packing for superheated steam and the Liberty power plant specialties such as tube cleaners, oil and water separators, strainers and oil purifiers. These are the well known lines of the Liberty Manufacturing Co., of Pittsburg.

They have also secured the eastern agency for the Locke engine stop and speed limit. This device which is manufactured by the Locke Regulator Co., Salem, Mass., makes it possible to stop the engine from any part of the plant, office or factory by simply pressing a button, so that in case of accidents there is no need to run to the engine room to acquaint the engineer of the fact. The speed limit is a simple device connected to the engine which "governs the governor" and makes a fly wheel explosion impossible. Catalogues of all these specialties will be sent on request.

Willis Chipman, consulting engineer, has moved from 103 Bay Street to larger offices in the Mail Building, Toronto.

SETTING VALVES OF LEONARD CORLISS ENGINE.

Continued From Page 30.

small petcock on side of vacuum chamber. This will reduce vacuum in low chamber, plunger will then seat itself without noise. Oil the dash-pots before you start engine through the top of the nut where the dash-pot plunger is connected with the rod.

Governor Dash-pot.

The governor dash-pot is used on Corliss engines to prevent over-sensitiveness of the governor and its response to trivial changes. Use only light oil in this pot, and regulate the size of hole in the piston if required to give greater freedom of motion. See that all parts of the governor move freely, and do not run the engine with the governor belt slack, it will not regulate satisfactorily if belt is slack, or if any part of the governor including the rods and knock-off levers are not perfectly free in their movements, oil the governor through the hole in top of the vertical spindle before starting up engine.

Using a Steam Engine Indicator.

Using a steam engine indicator to test the correctness of valve setting is the most approved method known, and should be applied in cases where an indicator can be obtained. Recollect that to adjust the point of cut-off to take same amount of steam at each end, adjust the cam or governor rods. To give more or less steam lead, adjust the wrist plate rods. Lengthening them increases the lap and shortening them gives more lead. The same with the exhaust valve; the cushion or release being effected thereby. If the eccentric is properly set it is not necessary to disturb it in ordinary cases. It is necessary to mark everything, so at a glance you can tell if it has been disturbed.

Latch or Hook Dies.

If the latch or hook dies have a tendency to slip, the latch spring may be at fault. It can be made stronger by twisting the spring stud, bringing more tension against the latch. If the stoppage comes from wear, take out the latch or stud die and turn it, thus presenting a new wearing surface, or sharpen edge by applying to a grindstone. Do not bring any more, pressure on the spring than necessary, as when steel dies are in good condition the tension of spring can be very light. Keep the cushion leathers on the pick-up hooks in good order and your valve gear working noiselessly and smoothly.

N.W.A.S.E.

By F. A. MacLean.

The charter to the North West Association of Stationary Engineers was obtained from the North West Government in May of 1907, and the first lodge was established in Calgary. Then other branches were organized in Medicine Hat, Lethbridge and Fernie, B.C. In March, 1908, the Edmonton branch was organized making five local lodges in all, consequently a relatively small aggregate membership when campared to older organizations, in the older and more populated provinces. However, this is a matter we will overcome as the province grows.

As regards the lines along which the association is run, I think the general principles are the same as C.A.S.E. The first object of the association is the education of its members by meeting once or twice a month for the discussion of questions in connection with engineering, also for those who are high up in the profession to assist those who are studying to pass the examinations, also if a member runs against a problem in his work, he brings it up at one of our own meetings where it is discussed thoroughly from every standpoint (as some brother member may have had the same problem to contend with) and will be able to give the enquiring brother just the information he requires. We also keep a general lookout for violations of the Steam Boiler Act and wherever we feel reasonably sure there is a violation we notify the inspector of the district, thereby assisting him to keep such violations down to a minimum.

The association also has its social side which is by no means the least. The engineers meet and get acquainted, and there is an occasional social meeting when the men bring their lady friends and have a general good time.

The Grand Lodge Convention is held once a year between Christmas and New Year's, at which the business pertaining to the Grand Lodge is dispatched, such as matters pertaining to the organization, also the best methods of obtaining amendments to the Act that we consider in the interests of the engineers and the public.

Officers of N.W.A.S.E., Edmonton, No. 5. Treasurer, Secretary, Vice-Chief, Chief.

THE COST OF THE INTAKE.

The necessity of having the air brought to the compressor in a cool, dry, pure state, is not sufficiently appreciated by engineers. As an illustration of the effect of the disregard of this rule the case may be mentioned of a well-known Mexican mine at which otherwise the heads of departments were earnestly working to reduce the operating cost. In this mine an electrically-driven air compressor was erected near the collar of the interior shaft, at a considerable distance from the mouth of the tunnel. The air entering the compressor was, of course, that of the room at the collar of the shaft, heated and vitiated by contact with the workings in heavy sulphide ores below. At some 10 meters from the compressor are well ventilated, dry and cool old workings, having a temperature of some 20 degrees below that of the compressor room. A drive of about 5 meters would have made a connection and the cool air so brought to the intake valve of the compressor would have produced an increase of 5 per cent. in efficiency. The annual operating costs of this compressor were: Power, $22,500; direct labor, $2,340; oil, repair, etc., $564; a total of $25,400, on which an increase of 5 per cent. in efficiency would make a reduction of $1,270.—Compressed Air Magazine.

Design of a Heavy Locomotive Type Marine Boiler

A Description of an Interesting Type Built for British Columbia giving the Special Features and Principal Dimensions of the Boilers.

By A. W. SPOTTON *

The Goldie & McCulloch Co., Limited, Galt, Ont., have recently supplied some marine boilers for use in British Columbia. These boilers were built for a working pressure of 200 pounds. The accompanying cut shows the boiler in course of erection and as will be noted the wagon top is of larger radius than the barrel and joined to it by a taper course. The fire box is exceptionally deep and provided with two fire doors, the upper one used when burning wood and the lower one when burning coal. The ash pit and smoke box are detachable and are bolted to the body of the boiler. The smoke box is provided with a spark hopper and spark arrester. The barrel of the boiler is 60 inches diameter and the wagon top 67 inches diameter. The fire box is 56 inches wide by 7 feet long and the boiler contains 156 tubes two inches diameter by 14 feet long.

The longitudinal seams are double butt strapped and double riveted, while the circumferential seams are lap and double riveted.

Dimensions.

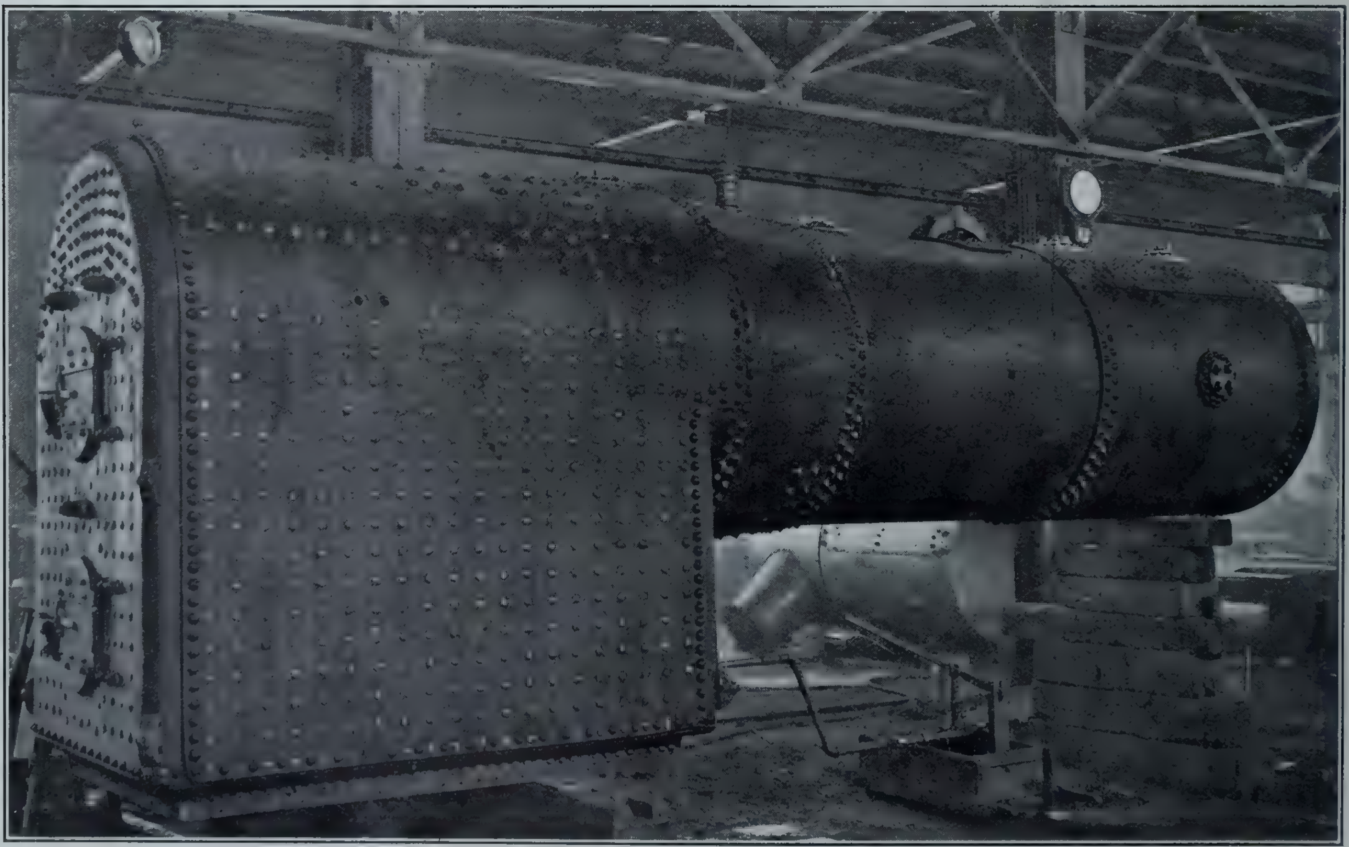
The following table gives the principal dimensions.

Diameter of barrel	60 in.
Diameter of wagon top	67 in.
Width of fire box	56 in.
Length of fire box	7 ft.
Number of tubes	156
Diameter of tubes...........	2 in.
Length of tubes	14 ft.
Length of smoke box	4 ft.
Overall length of boiler....	25 ft. 5 in.
Thickness of barrel shell	21-32 in.
Thickness of wagon top	32-32 in.
Thickness of tube sheet	9-16 in.
Thickness of crown sheet....	7-16 in.
Heating surface	1,300 sq. ft.
Grate surface	32.5 sq. ft.
Ratio of heating to grate surface	40
Working pressure....	200 lbs. per sq. in.

TUNGSTEN AND ITS USES.

A report prepared by T. L. Walker, M.A., Ph. D., for the Department of Mines, Ottawa, gives some data of the metal and its uses.

Tungsten is one of those rare metals which have become generally useful during the last few years. Formerly it was of interest chiefly because it was one of the rare chemical elements. Of late it has become an article of commerce and industry, and has attracted much attention on the part of iron masters, dyers, silk workers, electricians, and especially of those connected with the mining industry. During the middle ages one of its commonest ores was well known to the tin miners of Saxony and Cornwall. This mineral, which is now called wolframite, was named lupis spuma by Agricola in his master work on minerals, mining, and metallurgy, in the early part of the sixteenth century. In 1781, Scheele—a Swedish chemist—discovered the metal tungsten, which from that date



Heavy Locomotive Type Marine Boiler, Goldie & McCulloch Co., Galt.

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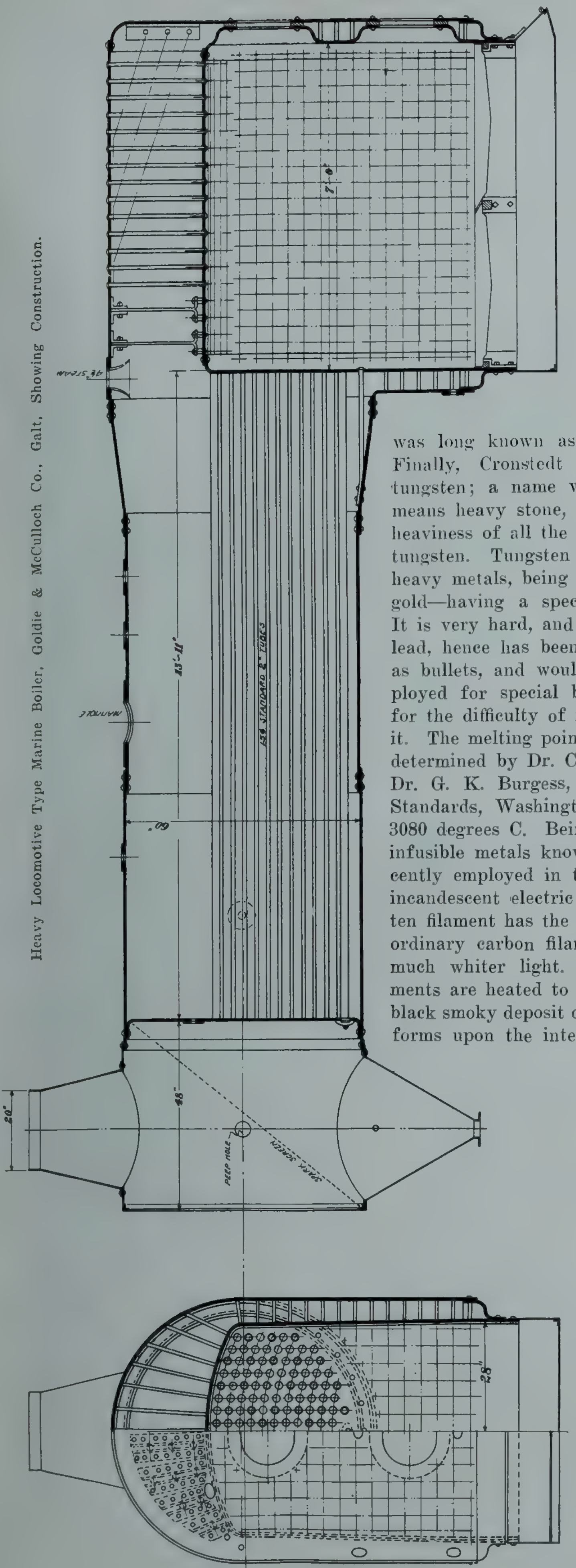
* Mechanical Engineer, Goldie & McCulloch Co., Galt, Ont.



Heavy Locomotive Type Marine Boiler, Goldie & McCulloch Co., Galt, Showing Construction.

was long known as Scheele's earth. Finally, Cronstedt called this metal tungsten; a name which in Swedish means heavy stone, in reference to the heaviness of all the minerals containing tungsten. Tungsten is one of the very heavy metals, being nearly as heavy as gold—having a specific gravity of 16. It is very hard, and much heavier than lead, hence has been suggested for use as bullets, and would doubtless be employed for special bullets were it not for the difficulty of fusing and forming it. The melting point has been recently determined by Dr. C. W. Waidner, and Dr. G. K. Burgess, of the Bureau of Standards, Washington, D.C., to be 3080 degrees C. Being one of the most infusible metals known, it has been recently employed in the manufacture of incandescent electric lamps. The tungsten filament has the advantage over the ordinary carbon filament of yielding a much whiter light. When carbon filaments are heated to a brilliant white, a black smoky deposit of volatilized carbon forms upon the interior of the bulb so that much of the light efficiency is lost; while the tungsten lamp will stand this white incandescent condition without any appreciable deterioration. Apart from this advantage, the manufacturers of the tungsten bulbs claim for their product a greater light efficiency for the electric energy consumed, even when compared with new, undimmed carbon bulbs. Considerable quantities of tungsten are consumed in the manufacture of tungstates, which are used as a mordant in dyeing, in giving weight to silk goods, and in rendering cotton fabrics fireproof. The chief demand for tungsten, however, is for the production of tungsten steel, which is also called wolfram steel. The addition of a small percentage of this metal increases the elastic limit and tensile strength. Tungsten steel is self-hardening, so that no special skill is required on the part of the blacksmith in the sharpening of tools made from it. Tools which have been heated are found to be well tempered as soon as they cool. These properties make this alloy very desirable for high speed tool steel. Similar effects are produced by adding molybdenum to steel.

Wolframite has been known since the middle ages to the tin miners of Cornwall and Saxony. It is black, or brownish-black in color, yields a red-brown powder, is very heavy, having a specific gravity of over 7. It frequently forms crystals almost metallic in lustre, which cleave easily in one direction, giving rise to thin, flat plates. In some cases, as for example some of the wolframite ores of Boulder County, Colorado, the mineral is almost massive, resembling very fine-grained, compact magnetite. Chemically it is an iron manganese tungstate, ramite fuses easily, and is only partially decomposed by the common acids. In Canada it is found in boulders near Lake Simcoe; at Kootenay Belle mine near Salmo, B.C.; and in small amount at Hardscrabble Creek, Barkerville, B.C.

Next to wolframite, scheelite is the chief ore of tungsten. This mineral is white, cream, yellowish, or brownish in color. It can be readily scratched by a knife. Its specific gravity is 6. At first sight scheelite suggests calcite or orthoclase; it is, however, far less easily cleaved and is more than twice as heavy as those minerals. More frequently it is confused with barite or heavy spar. In general its most characteristic property is its high density; none of the minerals resembling scheelite are as heavy. Its chemical composition is calcium tungstate, $CaWO_4$. Scheelite is found in Canada near Moose River mines, N.S.; Victoria mines, Ontario; Granite, near Nelson, B.C.; and near Barkerville, B.C.

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Canadian Society of Stationary Engineers.

President, Charles Kelley, Chatham, secretary, W. A. Crockett, Mount Hamilton P.O., Ont.

Toronto Branch C.A.S.E.

Meetings 1st and 3rd Fridays each month at Forum Hall, corner Gerrard and Yonge Streets. President, W. C. Tait; secretary, A. Kirby.

C.A.S.E. Exhibitors' Association.

President, W. R. Stavert, Jenkins, Montreal; secretary, John B. Goff, Dart Union Co., Toronto; assist. sec., G. C. Keith, editor The Power House, Toronto.

Canadian Society of Civil Engineers.

Rooms at 413 Dorchester Street West, Montreal. President, Geo. A. Mountain; secretary, Prof. C. H. McLeod. Meetings will be held at Society Rooms each Thursday. .

Quebec Branch of C.S. of C.E.

Chairman, L. A. Vallee; secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

Ottawa Branch of C.S. of C.E

Chairman, W. J. Stewart, Ottawa; S. J. Chapleau, Box 203.

Toronto Branch of C.S. of C.E.

96 King Street West, Toronto. President, J. J. G. Kerry; secretary, E. A. James, 62 Church Street.

Manitoba Branch of C.S of C.E.

Chairman, J. E. Schwitzer; Secretary, E. Brydone-Jack. Meets first and third Friday of each month, October to April, in University of Manitoba.

Vancouver Branch of C.S. of C.E.

Chairman, Geo. H. Webster; secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

Nova Scotia Society of Engineers, Halifax.

President S. Fenn; secretary, J. Lorne Allan, 15 Victoria Rd., Halifax, N.S.

Canadian Electrical Association.

President, N. W. Ryerson, Niagara Falls; secretary, T. S. Young, Canadian Electrical News, Toronto.

Universal Craftsmen Council of Engineers. Canada Council.

Chief, Chas. Mosley, 7 Charles St. W.; secretary, H. E. Terry, 157 Bay St. Meets second Tuesday in each month in Room 2, 4th Floor, Temple Building.

Toronto Branch A I.E.E.

Secretary, W. H. Eisenbeis, 1207 Traders Bank Building.

Engineers' Club of Toronto.

96 King Street West. President, C. M. Caniff, secretary, R. B. Wolsey, 25 Lowther Ave. Meetings every Thursday evening during the fall and winter months.

Edmonton Engineering Society.

President, Dr. Martin Murphy; secretary, B. F. Mitchell, City Engineer's office, Edmonton, Alta.

Canadian Railway Club. Montreal.

President, J. Duguid; Secretary-Treasurer, C. Powell, Box 7, St. Lambert, near Montreal. Meetings at Windsor Hotel, 1st Tuesday of each month, except June, July and August.

Central Railway and Engineering Club, Toronto

Presidene, J. Duguid; Secretary-Treasurer, C. L. Worth, Room 409, Union Station. Meetings at Prince George, 3rd Tuesday of each month, except June, July and August.

Western Canada Railway Club.

President, Grant Hall; secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Meetings second Monday, except June, July and August, at Winnipeg.

Ontario Municipal Association.

President, Mr. George Geddes, Mayor, St. Thomas, Ont.; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

Union of Alberta Municipalities

President, H. H. Gaetz, Red Deer, Alta.; Secretary-Treasurer, John T. Hall, Medicine Hat, Alta.

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President, Mr. A. E. McMahon, Warden, King's Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

Union of Saskatchewan Municipalities

President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

Union of Manitoba Municipalities

President, Mr. Menlove, Virden; Sec.-Treas., Councillor Cardale, Blanchard, Man.

Union of British Columbia Municipalities

President, Mayor Bell, Enderby; Sec.-Treas., Mr. Planta, Nanaimo.

Greetings From Executive Secretary.

At this season of the year when we all appreciate and welcome good cheer and express our thanks for good deeds done and wishes for mutual welfare, I desire to thank all those members and friends of the C.A.S.E. for their assistance and co-operation in advancing the best interests of our association. The support we have received has been of such a character as to help build up our membership. From all over the Dominion letters are being continually received containing expressions of sympathy with a cause which is gradually forging to the front. We would kindly remind you of our preamble and say that we wish it to be understood that we are not desirous of changing our attitude in the matter because we have done and are still doing good work in the endeavor to build up and place upon a higher plane the profession of stationary engineers.

> "Order is heaven's first law and this
> confessed
> Some are and must be better than
> the rest."

I believe that every member of our association is above the puny bickerings that take place in some quarters. I am persuaded that a bright future is in store for us and I am convinced that ere long steps will be taken to assist all who are desirous of attaining to higher branches of the profession. Co-operation is a wonderful factor and when all engineers see their way clear to join hands with us a better enactment of the License Law will be assured. I am credibly informed that the resolution presented to the Hon. the Minister of Agriculture, will be dealt with fully. There are many who denounce the Act because of its laxness and complaints are coming from many sources that the law is inoperative and many argue: What gain have we under the circumstances Why pay for what is of no benefit? Why should I pay and another be allowed to operate a plant without having paid for his certificate? Many are the complaints it is true and this is a reason for the co-operation of all who have paid their fee, to work for a better enforcement of the Act. "A house divided against itself can never stand," is old but true. Then do not allow any factor to draw you from your allegiance to a society that has by it works proved that it has faith in a final adjustment which shall be equitable to all.

I should have liked to pay a visit to every lodge and discuss matters with you but am not in a position to do so at present. My great desire and wish to you all is that you enjoy good cheer, health, and prosperity, and so wish you all a Merry Christmas and a Happy New Year.

Fraternally,
W. A. CROCKETT.

No. 1. C. A. S. E.

On January 21, 1910, the Toronto branch C.A.S.E. will hold an open meeting when Prof. Bain, of Toronto University will deliver a lecture on "Boiler Waters." The lecture will be illustrated with some simple tests for the determination of scale forming matter and its prevention.

On February 18, R. C. Harris, property commissioner, Toronto, will deliver an address on "Smoke Abatement." This, at the present time is a very live question

Both these lectures will be held in the Forum Building, room 29, corner Yonge and Gerrard Sts., Toronto, at 8 p.m. All engineers are invited to attend.

Stratford C.A.S.E. Banquet.

Stratford Lodge No. 31, C. A. S. E. will hold a banquet in the Albion Hotel, Stratford, on Friday, Feb. 4. J. A. Robertson, president, and W. G. Walters, chairman of committee, have charge of arrangements.

N.S. Society of Engineers.

The regular monthly meeting of the Nova Scotia Society of Engineers was held on Jan. 13, in the Nova Scotia Technical College, Spring Garden Road, Halifax. Transportation in relation to Nova Scotia was discussed. Members from the different part of the province prepared papers dealing with the subject from the standpoint of their own districts, so that the question was fully discussed, setting forth the interests of all Nova Scotia.

Engineering Society, Queen's.

The Engineering Society of Queen's University, Kingston, held their thirteenth annual dinner on December 15th, 1909. The attendance was large, the speeches bright and the guest list representative. After the toast to the King had been received Principal Gordon proposed Our Country. M. J. Butler, Deputy Minister of Public Works, Ottawa, was the first to reply. Mr. Butler referred to the place of the engineer in nation building and referred to transportation as the present great Canadian problem.

The University was proposed by Chas. Macdonald, B.A., past president of the American Society of Civil Engineers, and replied to by Dr. Jordan.

In proposing the Profession, Prof. L. W. Gill referred to the desirability of engineers taking a more prominent place in the social and political life of a country. He also thought the engineer should enter the field of management in industrial corporations. In reply R. W. Brock, Director Geological Survey of Canada; H. E. T. Haultain, Professor of Mining, Toronto University; C. H. O. Pook, Canadian Westinghouse, Hamilton and R. H. Seely, Hamilton. The Faculty were proposed by A. M. Bateman, and responded to by Dr. Goodwin and Prof. McPhail.

S.P.S. Engineering Society.

The Ontario members of the Canadian Manufacturers' Association connected with industries pertaining to engineering are to be entertained at the 21st annual dinner of the Engineering Society of the Faculty of Applied Science of the University of Toronto, to be held on Wednesday, January 18th, in Convocation Hall Annex. The members of the Ontario Cabinet and of the University Board of Governors will also be guests of the society.

Arrangements have been made for a lecture on Jan. 25, by Charles Y. Knight, inventor of the Silent Knight automobile motor, under the auspices of the Engineering Society of the University of Toronto. The lecture will be illustrated by use of drawings, showing the radical difference between Mr. Knight's invention and the valve type of motor heretofore used. The Knight engine has an object of interest in motoring circles, owing to its tests by the Royal Automobile Club of Great Britain and Ireland and its adoption by a number of automobile manufacturers.

Railway Educational Club.

A Railway Engineman's Educational Club has been organized in Winnipeg and Kenora. In the former place there is a membership of 250 and 50 in the latter. The headquarters of the organization are in the Empress block, Winnipeg. The following are the officers: President, C. A. Boyd; Vice-president, J. McLachlan; Secretary, G. F. Collins; Treasurer, W. S. Metcalf.

Western Canada Railway Club.

The regular monthly meeting of above club was held in the Royal Alexandra Hotel, Winnipeg, on Monday evening, January 10th, at 8 o'clock. A paper was read by A. E. Cox, storekeeper, Canadian Northern Railway, on "The Stores Department and its relation to the other departments." There was also a continued discussion on "Water Supply," and "Copper versus Steel Fireboxes."

Central Railway and Engineering Club.

The regular monthly meeting of the Central Railway and Engineering Club was held at the Prince George Hotel, Toronto, December 21, 1909. The business of the evening consisted of an address on "The Manufacture of Commercial Gas," by C. J. Herring, chief draftsman, Consumers' Gas Company, and the election of officers for the ensuing year. Mr. C. A. Jefferis, the retiring president, occupied the chair. The following were elected officers: Pres., J. Duguid, general foreman G.T.R.; first vice-pres., G. Baldwin, general yard-master Canada Foundry Co.; second vice-pres., J. Bannon, chief engineer, City Hall, of Toronto. Executive committee, Messrs. C. A. Jefferis, master mechanic, Consumers' Gas Company; W. R. McRae, master mechanic, Toronto Railway; O. A. Cole, Philip Carey Mfg. Co.; A. M. Wickens, chief engineer, Canadian Casualty and Boiler Insurance Co.; A. E. Till and A. Taylor, of Toronto, and Mr. Paterson, master mechanic, G.T.R., of Stratford.

On Jan. 18, 1910, J. Bannon, chief engineer, City Hall, Toronto, will read a paper on "Heat Regulation."

Union of Manitoba Municipalities.

The sixth annual meeting of the Union of Manitoba Municipalities was held at Portage la Prairie recently. There was a large attendance, more than 200 delegates being present. J. C. Menlove, Virden, presided. Dr. A. J. Douglas, Winnipeg, and Mayor Harvey, Dauphin, read papers on Waterworks and Sewage Disposal Systems. A paper on "Good Roads" was read by C. H. Dancer. The Good Roads Association of Manitoba recommended the appointment of a Government Highway Commissioner. Officers were elected as follows. President. Menlove, Virden; vice-pres., Reeve Forke, Pipestone; sec-treas., Councillor Cardale, Blanchard; executive committee, Reeve Thompson of Assiniboia, Mayor Harvey of Dauphin, Reeve Allan of Odonah, Reeve Willis of Morton, Reeve Poole of Archie, Councillor Thompson of Portage and Cont. Waugh of Winnipeg; Solicitor, Mayor Adolph of Brandon.

Engineering Club, Toronto.

The officers for 1910 were elected at a meeting of Toronto Engineers' Club, December 16, as follows: Hon. president, Professor Galbraith; president, Willis Chipman; first vice-president, C. M. Caniff; second vice-president, Prof. R. W. Angus; chairman library committee, W. Almon Hare; chairman rooms committee, W. V. Reynolds; chairman papers committee, C. R. Young, B.A.Sc.; treasurer, L. J. Street; secretary, B. Wolsey.

At the meeting on January 6, 1910, Willis Chipman resigned and C. M. Caniff was elected president. A. F. McCallum, city engineer, Hamilton, was elected vice-president.

At the first meeting of the year, Dec. 6, editorial representatives of the Technical Press, led by E. A. James, B.A.Sc., editor of the Canadian Engineer, discussed the relation of the engineer to the technical press. He was followed by G. C. Keith, B.Sc., editor of The Power House, who pointed out the marked improvement in the technical press of today over that of a few years ago. The educational features were also emphasized.

K. A. Mackenzie, editor of Applied Science, said that the Canadian journals were recognized in other countries as a live force in engineering journalism. The text-book of to-morrow was practically a rehash of the technical press of today. This he had proved by actual experience. Other speakers were J. C. Armer, B.A.Sc., editor Canadian Manufacturer, Ivan S. McDonald, editor of Construction, A. E. Uren, editor of of Cement and Concrete Review. There was a good discussion in which Dean Galbraith, A. F. McCallum and C. R. Young took part. C. M. Caniff occupied the chair.

On January 20 Prof. R. W. Angus will give an illustrated address on "Turbine Pumps." This address will be given in the new thermodynamic and hydraulic laboratory building of the University of Toronto, and will be followed by a practical demonstration in the laboratories, which will be in operation for the occasion.

Canadian Society C. E.

The twenty-fourth annual meeting of the Canadian Society of Civil Engineers will be held at Ottawa, Ont., on Wednesday, Thursday and Friday, January 27, 28 and 29, 1910. Several important reports will be given and there will be a number of excursions to works of interest to engineers.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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UNIFORM BOILER CONSTRUCTION LAWS.

A conference of great importance to the manufacturers and users of boilers was held in Regina, Dec. 1-11, at which the Governments of several of the provinces were represented. British Columbia was represented by J. Peck; Alberta by Wm, Hobson, David Fraser, Joseph Buxton, David Fraser and Samuel Marshall; Saskatchewan by B. M. Smyth, Thos. Inglis, Wm. Mayhew and R. N. Blackburn; Manitoba by Chas. H. Dancer and H. A. Bowman, and Ontario by D. M. Metcalf. Through a misunderstanding Quebec was not represented.

The question of engineers' certificates was not taken up, this being left to the individual provinces to be dealt with as they saw fit. The time was taken up wholly with uniform boiler construction regulations. Those drawn up were presented by J. W. Horkom, representing the Canadian Manufacturers' Association, and it was decided to recommend their adoption by the various provinces. It is hoped that there will be as little delay as possible in the adoption of the regulations.

At the present time manufacturers are handicapped in building boilers for the other provinces. At the present time a large percentage of the boilers used in Canada are manufactured in one or two provinces, and patterns made to the specifications of one province cannot be used in constructing boilers for another province, a situation which is manifestly unfair to the manufacturer. It increases the cost of manufacture, and boilers cannot be built with the same facility as they could if there were standard patterns.

If uniform regulations are adopted, a different state will exist. The manufacturer having standard patterns will build a better boiler at less cost and the workmen will become more efficient. The consumer will get a boiler that can be used in any province. The manufacturer will be able to stock boilers and a consumer in any province can get an immediate delivery. An engineer will understand all boilers, because they will all be built to standard specifications.

◆

ONT. STATIONARY ENGINEERS' REGULATIONS.

The Stationary Engineers' Board of Ontario, have decided that on and after April, 1910, application forms B and C will be discarded and thereafter only the application form for examination will be accepted.

The purpose of this is to issue certicates, only to those who qualify by examinations. At the present time certificates are issued to every engineer who, at the time of the passing of the Act, (April, 1907)—

(1) Held a certificate of qualification from any association of stationary engineers in the Province of Ontario.

(2) Held a marine or locomotive engineer's certificate.

(3) Was actually in charge of a steam plant of 25 h.p. or over, in the Province of Ontario, or who, not being in charge of such a steam plant, had had at least two years' experience in the operation of such a steam plant.

After April 1 certificates of competency will be issued by the Government only to those successfully passing an examination prepared by the Engineers' Board. Any person entitled to a certificate under the provisions mentioned should make application at once on forms obtainable from the Stationary Engineers' Board, Parliament Buildings, Toronto, otherwise they will be compelled to pass an examination to secure their certificate.

On Dec. 13 a representative deputation of stationary engineers from the Union and C. A. S. E., waited on the chairman of the examining board and made some suggestions to make the Act respecting Stationary Engineers more workable. They will wait on the Minister of Agriculture and bring their suggestions to his notice.

They suggest that the Act apply to all engineers operating steam plants over twenty-five horse-power and to engineers in charge of steam heating plants operating at a pressure of over ten pounds. In order to enforce the Act more strictly, they suggest that the examining board be given power to enforce the Act and to prosecute any violation of same.

They also suggest that those who wish to take the engineers' examination should have at least two years' practical experience in a steam plant. It was thought by the deputation that the adoption of these suggestions would greatly strengthen the hands of the board and also that the employer would be assured that he was getting a fully qualified and experienced engineer.

SECRET COMMISSIONS ACT.

In New York manufacturers are having trouble with secret rebates and the practice is strongly condemned by the New York Journal of Commerce. An act such as the Canadian Secret Commissions Act would evidently be very acceptable to those who have to put up with the unfairness caused by giving secret rebates.

The Journal of Commerce says under the heading "Rebating is Dangerous":

> One of the propositions which causes the wholsaler about as much trouble as any other is that of the practice on the part of the traveling salesman of giving rebates from his pocket. It is a two-edged sword, which hits both at the house and at the salesman. Besides the direct money involved, it often places the employer in a position where the employe does something that causes much embarrassment in more ways than one.
>
> Too often the salesman is anxious to make a record of selling a large amount of goods and sends in his orders at regular prices, but digs down in his pocket and hands back to the buyer enough to make up the difference in the figures between what he should get and what the buyer is willing to pay.

The Canadian Act is a move in the right direction. As one engineer writes us:

> "In publishing the Secret Commissions Act you are certainly doing every engineer a great kindness, for, I think, lots of them have no idea they are breaking the law in accepting a commission from an oil man or one selling compounds or packing. It is time that agents obtained their business without having to stoop to such tricks of the trade."

Interviewed, Canadian manufacturers think the Act a proper one and everyone interested should assist in its enforcement. The St. John, N.B., Board of Trade have taken an active interest in this act and a copy has been mailed to each member. T. H. Estabrooks, president of the St. John Board of Trade writes:—

> "Rebating, secret commissions, etc., have not yet become at all as serious in Canada as in the United States, but nevertheless, there is too much of it."

Manufacturers generally recognize that the Act is a move in the right direction. It therefore behooves all to see that it is enforced and that products are sold on their merits.

◆

THE STUDIOUS SEASON.

During the winter months the engineer has spare time on his hands which he can turn to great advantage. If he wishes to obtain a complete knowledge of his profession, or if he desires to become worthy of consideration of promotion, or if he wishes to gain the esteem of his employers, he cannot do better than spend a portion of his spare time during the winter months in a search for knowledge. He cannot do better than read regularly a good technical paper.

The Technical Press opens up new fields for thought with which he could not become acquainted in any other way. It keeps him informed on developments in present-day practice, it explains principles and subjects and thus increases the knowledge and possibilities of the engineer.

Much technical literature is unsuited for the student who spends eight or ten or twelve hours in the engine room. For these we are making careful selections and each month there will be a number of articles in The Power House dealing with the fundamental principles of certain subjects. In this connection many engineers and students who will be the engineers of the future, will welcome the re-appearance of Mr. Crockett's course of lessons.

Apart from his mechanical experience, every young man should devote a proportion of his time to study. With the revival of business, there will be an increased demand for engineers who understand steam, electricity, refrigeration, etc., and one of the best methods of obtaining a comprehensive knowledge of these subjects is by perusing carefully, each month, his technical paper. He will there glean information which will be invaluable to him, and he will then thank the publishers who keep him informed on modern developments and practice.

◆

BOILERS REQUIRE CARE.

"We find that John Pickering came to his death by being scalded by water escaping from a boiler not properly blown off, and the D. B. Martin Co. be censured. It is our opinion that the engineer should have seen that the water was all out of the boiler."

The foregoing verdict was brought in at the Morgue, Toronto, Sept. 29, 1090, by a jury under Coroner Hopkins, touching the death of John Pickering, an employe of the D. B. Martin Abattoir, who died in the Western hospital from injuries received by the blowing out of a hot water pipe. Boilers are not play toys. They require careful handling. You cannot play with a match in a powder magazine. The result will be disastrous.

◆

ONE GAG TO TRADE.

It is often a difficult proposition to discover why some lines find an absolute stone wall in front of them when seeking orders from engineers and owners. Sometimes no excuses whatever are offered the salesman—he is simply turned down, frequently with rude emphasis, but in each case with no chance of a comeback.

We have recently noticed what might be the reason in the majority of cases, and it is this: A municipal officer, who has the power of decision as to what is right and wrong in power plant instalations, has an interest in a certain specialty and refuses to pass any plant in which other devices are used as a means to the same end. The result is that it is practically impossible to sell similar devices in the municipality in which this officer has authority. Of course, his name does not appear in any of the circular matter concerning this specialty, but the canker is there, and it seems a pity that such a prejudiced person should be holding down a job as a "public servant."

One way to combat an evil like this rests with the engineers-in-charge themselves. When they discover even so much as a hint that crooked work of this kind is going on, they should make it known. They should not be afraid to use the public press nor their trade journal in the endeavor to get rid of this "gag to trade." A fair deal to all lines is only right; make the specialties prove themselves. The majority of makers will stand behind their product with reasonable guarantees and will put it in on trial for any responsible firm or engineer. But the main point is Do not be afraid to put up a good fight against anyone who tries to tie you down to one particular line. And, above all, do not be afraid to expose any municipal official who endeavors to create a monopoly for the goods in the sale of which he is interested.

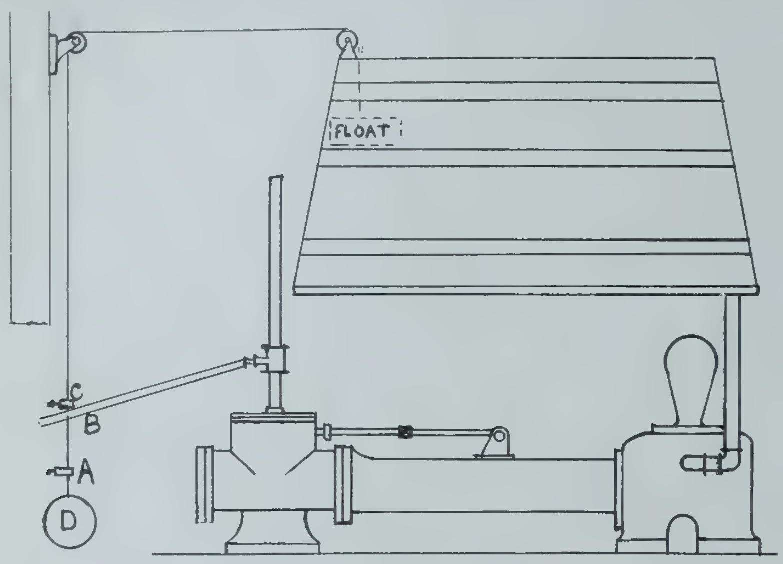
PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

PUMP REGULATOR.

By Frank H. Chester.

A device along the line of a pump regulator, such as I am about to describe is not only handy and easily made, but it gives good satisfaction.



Handy Pump Regulator.

It consists of a float to which is attached a cord, passing up over a pulley secured at the top of a tank and down over another secured to a timber in the pump house, and on down to the pump. The cord is fastened to a rod at the pump throttle, which is secured in a vertical position so that it will move freely up and down as the float in the tank directs.

On the rod are two stops which may be adjusted by the set screws as shown in sketch. The nearer the stops are together, the more evenly the water level will be maintained.

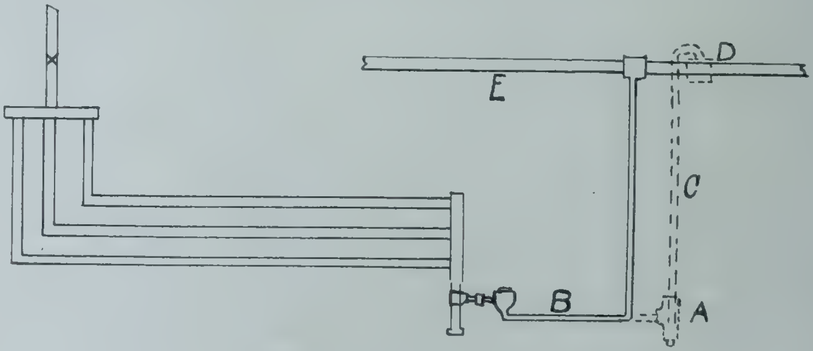
In the steam pipe of the pump a crane throttle valve is to be placed, with a piece of iron secured to the handle, having a hole drilled in it through which the rod passes, the hole being large enough so as not to bind the rod when in the position shown, or in a higher position.

The operation is simple. The illustration shows the throttle valve of the pump shut off and the pump not working. If, however, the water supply in the tank is lowered, the float drops and the stop A rises until it hits the lever B, of the throttle valve, and opens the throttle and the pump starts. This continues until the tank is full enough to raise the float so as to cause the stop C to strike the lever on the other side and close the valve. This is accomplished by having a weight D, attached to the rod below the stop A, heavy enough to swing the lever shut and no more. Of course the float in the tank must be heavy enough to counterbalance the arrangement. In this way a constant water level is maintained and the annoyance of either having the tank running over or half empty is done away with.

CURING STEAM COIL TROUBLE.

By R. McLaren.

A steam coil had a habit of filling up with water when steam was shut off.



Curing Steam Coil Trouble.

The drain connected to return main are shown in the full lines in the sketch.

The connection was changed as shown by the dotted lines, in which A is a tee, two sizes larger than pipe B. C has a long thread on one end and screws into A until end is lower than B. D is a return bend and E is the return main.

The vacuum pump is now able to drain coil and B dry. D prevents water from flowing back into return main and there is no trouble now.

SAFETY APPLIANCES.

By James E. Noble.

The confiding public as a rule are firmly convinced that a steam boiler is safe if it has a safety valve. Perhaps it is if the valve is large enough to take away steam as fast as the boiler can make it, that it is set at a working pressure that the boiler will stand, and that the valve is in good condition and that the engineer is an engineer. One plant in this Canada of ours where I was sent to do some repairs some years ago, had the safety valve outlet covered with a blank flange. The engineer's reason for fixing things in this way was because the safety valve would persist in leaking. (This is a fact).

A short run around Toronto will convince the power plant visitors that it apparently is the policy for many owners to have the steam gauges put into as dark a corner or spot as possible and to have them as small as possible. I believe there should be a law compelling the use of steam gauges on high pressure boilers to be at least nine inches in diameter and to have them in a place where the engineer will not have to guess at the pressure or climb a ladder and light a match to read the gauge.

A high and low water alarm is another piece of apparatus which would greatly assist in making a steam plant a safe spot. If a fireman is careless the alarm will at least notify the chief that the boiler attendant is not attending to the water level, and rather than risk dismissal, an attendant will be more careful.

Engineers and firemen should get at least laborers' wages and hours. I know engineers who get less than $2 a day, who have to put in extra time and get no extra pay. I believe an engineer should get an eight or ten hour day and get paid extra for every extra hour he has to put in on repairs or other work.

VALUE OF WATER POWER.

By M. E. D.

One handy formula for horse-power of falling water, assuming 80 per cent. efficiency for the wheel, is:

(1) $\text{horse power} = hq \times .09$

in which h=effective head in feet,

and q=quantity of water in cu. ft. per sec.

The total or theoretical horse-power as given by the formula is:

$$(2)\quad \text{horse-power} = \frac{hq \times 62.5}{550}$$

where q=cu. ft. per second.

and h=effective head in feet.

Another formula used by some prominent Canadian engineers is the following formula:

$$\text{Horse-power} = \frac{hq}{12}$$

(3) where q=cu. ft. per second.

and h=effective head in feet.

This formula gives 75 per cent. of the total power, but is the effective horsepower available.

LENGTH OF BELT.

By K. Campbell.

The following is a simple rule to find the length of belt required to transmit power between pulleys. Double the distance between centres and multiply by 1.57. Example: Twelve feet between centres of pulley, one 3 ft. and one 6 ft.

$12 \times 2 = 24$; $6 + 3 = 9$; $9 \times 1.57 = 14.13$

Length of belt=24+14.13=38.13 ft.

For a double belt multiply the diameter of the pulleys by 1.74.

$12 \times 2 = 24$; $6 + 3 = 9$; $9 \times 1.74 = 15.66$.

Length of crossed belt=24+15.66=39.66 ft.

CRANK AND CROSSHEAD SPEED.

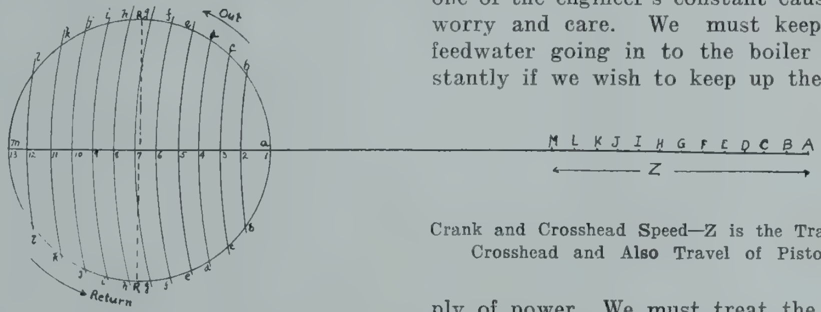
By Geo. B. Rexford.

The object of this diagram is to show, 1st the speed of the crank compared with that of the crosshead, which is the same as the piston, 2nd, to show that half crosshead or piston stroke is not the same at half crank stroke, either in the out-going or return movement, and 3rd. that the crosshead and piston travel slower at the crank end than at the head end.

Let the circle represent the disc of a 10''×12'' engine, having a connecting rod 27'' long. Let the arc b b be drawn with 27'' radius from the centre 13 and c c from C, etc. Let the space between A and B, and 1 and 2, each represent 1 inch. When the crosshead is at A, the crank is at a; when at B, the crank would be at 2, if disconnected and keept horizontal, but when connected would be at b, (radius of same circle), etc., until they are respectively at M and m, when the return movement begins.

Now the crank disc must turn at the same speed all the way round, as it is connected to the heavy flywheel, and also to the load which it carries. While the crosshead and piston travel from L and M, the crank must travel from l to m on out-bound, and from M and L, and m and l on return movement, respectively, as the space from l to m and from m to l is the greatest, therefore the slowest movement of the crosshead or piston is from L to M and from M to L. Its next slowest movement is from A to B, and from B to A. When the crosshead is at G, it is at half stroke; the crank would then be at g, but K on a line drawn perpendicular from 7, is half crank stroke. If an arc was drawn from k to k with a radius the length of the connecting rod with its-centre upon the line A M it would be near H, which would be the position of the crosshead and piston when crank is at half stroke.

As the space from l and m is greater than from a to b, and k to l greater than from b to c, etc., the speed of the crosshead and piston is greater at the head end than at the crank end. As the shortest space between radial lines is from d to e, e to f, f to g, the fastest crosshead piston travel is from D to G out-bound and from G to D return movement.



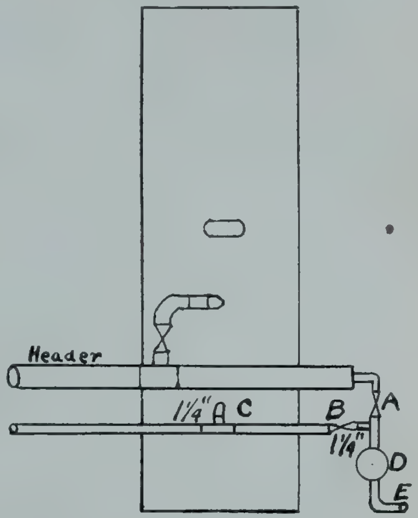
Crank and Crosshead Speed—Z is the Travel of Crosshead and Also Travel of Piston.

REDUCING COAL BILL.

By J. Mitchell.

Every little move which reduces the coal bill, is worth trying. The following is one which can be used to advantage wherever low pressure steam is used.

When shutting down a boiler, there is always a considerable amount of steam left in it which can be utilized if suitable piping is installed. Referring to the sketch, valves B and C are closed and valve A is open when the boilers are in service. When shutting down or changing the boilers, close valve A and open valves B and C, and let them stay open as long as there is steam enough to keep the proper pressure on the pipe line. In this way the writer gets from an hour and a half to eight hours drying, according to conditions, once a week.



Reducing Coal Bill—A is 1¼'' Globe Valve ; D is Foster Reducing Valve ; and E is Pipe From Steam to Dry Room.

BOILER FEEDWATER PROBLEMS.

By John Thurlow.

The purifying of boiler feedwater is one of the engineer's constant causes of worry and care. We must keep the feedwater going in to the boiler constantly if we wish to keep up the supply of power. We must treat the feedwater by some process or other to kill scale-forming substances in the feedwater, and thus prevent it forming a scale on flues and plates of boilers. Numerous makes of boiler compounds are sold and used for the purpose of removing old scale and also for the prevention of new scale, many of which are about 96 per cent. water with a sufficient quantity ol soda to soften the water somewhat, and then some coloring to make it look fancy.

Sal soda can be bought for 90c per cwt. by the keg, and if fed slowly and constantly, and in proportion to size of boiler and amount of water evaporated, will give better results than a large percentage of the manufactured compounds.

Some feed compounds into boiler at end of day's run and expect good results from this procedure, I always found that by feeding slowly and continuously they give much better results.

I put a tee on suction pipe and put an upright in tee, had a can with a tapered bottom in it (funnel shape), which entered the top of upright pipe, I then had a ¼-inch pipe come to the top of the can and a valve on same 6 inches up from can. Live stean was turned on this pipe and valve opened enough to allow hot condensation to constantly fall in can on to the soda, gradually dissolving it. The liquid soda passed down into pipe, and thence to the feedwater where it was pumped into boiler. This was removing scale splendidly, then we installed one of "Myers Automatic Boiler Cleaners," and we quit using soda.

Two hours after we had been running we took out a sample of the deposit and it was quite dry. Twenty-four hours after starting machine, the deposit, when allowed to settle, was half mud. We used boiler for six weeks and when we opened boiler, the water was as clear as if taken direct from blow off. The plates in bottom were as clean as when new. Next run was 14 weeks with same results. This is on a 60 hour a week run.

It is eight weeks since last opening and water shows up as clear as crystal in glass. It also stopped scum from passing over to engine, something which caused me considerable trouble. The old scale that was on is rotting, and falling off, but as all mud is kept out by skimmers, there is no danger of burning plate as water can circulate through scale so long as no mud is present.

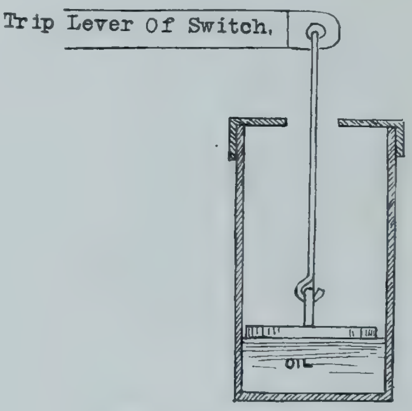
A Moffat heater does its share towards removing scale forming substances, as it has to be cleaned out every four weeks regularly and top chamber is almost solid, as there is such a thick deposit of lime, etc., in the excelsior which we use as a filter. Condensation is another big factor in keeping boiler clean, especially where considerable is returned to boiler.

HOME-MADE TIME-ELEMENT DEVICE.

By J. A. S. Newcastle.

At the present date the inconvenience and positive danger of having an instantaneous operation of an automatic circuit-breaker directly the limit load is reached is so well known that it is safe to say that every modern electric power equipment includes on its switchboard gear a time-element device of some sort operating in conjunction with the automatic cutouts on the main circuits. A few years ago, however, this was not so generally known, with the result that there are still main switchboards in operation for direct and alternatinfg current power supplies whose circuit-breakers fly out directly the load which corresponds to their setting is reached.

This is a particularly serious inconvenience where the power requirements of large motor units form a large proportion of a station load, as for example, where the equipment of a large works includes a private power house. Momentary overloads on the cable are constantly occurring, due to the peak fluctuations of various motors on a power circuit coinciding with one another, and the result is that the automatic overload circuit-breakers on the main switchboard repeatedly operate and cause inconvenience in periodically and unexpectedly shutting down the motors and machines. The usual method of getting over this trouble, to be found in many power houses where the problem has been left to the unassisted intelligence of the switchboard attendant, is to wedge up the circuit-breakers with little bits of wood so that they are practically eliminated from the circuit. The dangers attendant on this practice, which is all too common, need not be dwelt upon; they serve, however, to emphasize the incompleteness of design of the ordinary form of breaker.



Home Made Time Element Device.

A more satisfactory home-made arrangement for the purpose of meeting this trouble has, however, been in operation for some time in a power house, and may be interesting to other engineers. This time limit arrangement, shown in the sketch, consists of a small brass piston 1¼ in. in diameter, which hangs in a vertical brass cylinder. The piston is in contact on its under side with oil contained in the cylinder, the piston just resting on the surface of the oil. The piston "rod" is attached, as shown, to the trip gear of the switch, and according to the viscosity and surface tension of the oil, so the time element introduced in overcoming the sucking action of the oil is varied. The time required to operate the switch is therefore ruoghly adjusted by means of adding a few drops of paraffin oil to dilute the cylinder oil used in the cylinder. In combination with a spring this arrangement could be made adjustable without varying the nature of the oil used, and could be roughly calibrated, but in the form described above it has been subjected to practical operation for a considerable time, and has been found to be quite satisfactory.

EFFICIENCY OF AIR LIFT PUMPS.

In a discussion before the American Society of Mechanical Engineers, F. A. Halsey gives the following interesting comment on air lift pumping. The air lift pump is one of those things of which our knowledge is almost exclusively experimental. Its analysis presents such serious difficulties that rational equations for the performance of the apparatus have not been derived by anyone to my knowledge. Under these circumstances, we are reduced to experiment for the determination of the fundamental laws of the performance of the apparatus, and these experiments should cover a wide range in the conditions which lead to variation in the performance of apparatus, namely, depth of submergence and lift. The most complete experiments now on record were presented in a paper before the British Institution of Civil Engineers in 1906, these experiments being of sufficiently wide scope to supply a satisfactory guide for the design of these pumps under a considerable range of conditions.

One curious feature attends the behavior of the air-lift pump and the Taylor hydraulic air compressor, which are essentially the same apparatus, reversed in action. In each case we have a pair of vertical pipes communicating at the bottom, one filled with water and the other with a mixture of air and water —a sort of suds. If the pipes are of indefinite length the columns will take levels corresponding with their respective gravities, but if the suds pipe is cut off below this level it will overflow, the suds will rise, and we have an air-lift pump; while on the contrary, if the water pipe is cut off below this level, it will overflow, the column of water will rise, and we have a Taylor hydraulic air compressor. The point to which I refer is that while the first of these constructions has a low, the second has a high efficiency. The highest figure given in this paper for the efficiency of the pump is about 28 per cent., and while 40 per cent, has been reached in exceptional cases, the average is probably not more than 20 per cent. On the other hand, the efficiency of the hydraulic air compressor is in the vicinity of 75 or 80 per cent.

WHAT STEAM ENGINE PISTONS ENDURE.

The steam-engine concern with which I am connected had a letter from a customer who complained about the wearing out of their pistons, and suggested a change, says a New York superintendent writing to The American Machinist.

In looking over the history I found that the engine was 12-inch stroke, ran 300 revolutions a minute, and had been running nine years.

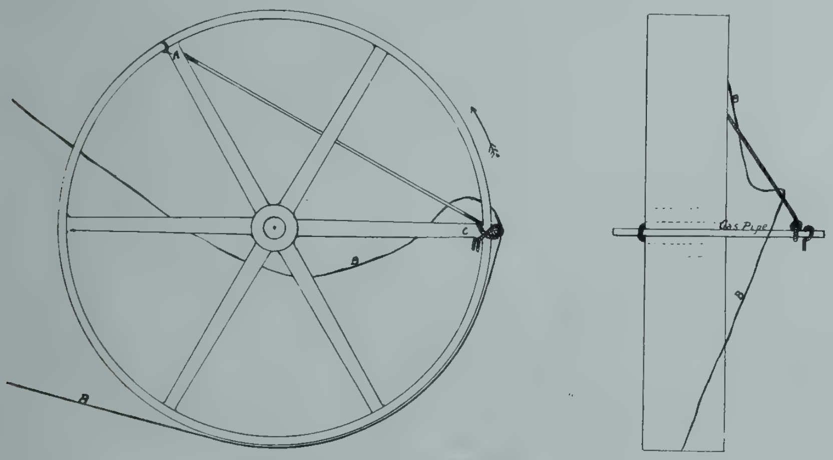
There was nothing unusual in this, as no doubt all builders can show as good, or better, records; but assuming, as probable, the engine had run 10 hours a day for 300 days in the year, that piston had travelled no less than 184,000 miles in the cylinder. Probably readers will not want to credit this until they have confirmed the figures.

This seemed to be such a revelation to me that I began investigating, and found that one party had one of our engines of 16-inch stroke that was put running January 1, 1893, and has run 24 hours a day for 6 days in the week, 200 revolutions per minute, for over 16 years, making a journey all told of over 696,000 miles. Is it any wonder that pistons and rings and cylinders wear out?

TO PUT ON DRIVE BELT.

By Frank E. Booth.

As is well known, a large belt is usually put in its place by tieing it to the drive wheel rim and turning engine over.



To Put on Drive Belt.

The objection to this method is that the belt gets twisted and crumpled very often, which might shorten its life of service.

While instaling an engine in an electric power house up the country, the writer saw the engineer work a first-class scheme for putting on a large drive belt, which is illustrated by the accompanying sketch.

A piece of wrought iron pipe was placed across the face of the wheel, as shown, being tied with a piece of rope to the wheel arm C, at one end, while a longer rope was run to the arm A, from the other end. The belt had approximately the location, as shown by heavy line B, when the engine was turned over; the long rope being underneath belt. The belt will slide on quite smoothly when the wheel is moved in the direction shown by arrow.

AN EMERGENCY PUMP REPAIR.

By Gymnite.

As engineer of our home water supply it was recently up to me to find out what was the matter with the windmill which was apparently working all right but not furnishing the usual quantity of water.

Several times I had been obliged to reprime it after it had been idle for a day, and finally suspected something wrong with the plunger. Examination showed that the cup leather of the pump piston was worn out on one side and worthless. We were out of water and could not get a new cup leather until the following day. I had nothing on hand but some good box-calf trimmings from the shoemaker's bench which I use for various jobs, and finally decided to improvise a cup leather from this as follows: I cut a washer 1 inch larger in diameter than the pump piston, making the hole slightly smaller than the threaded portion over which I worked it to the shoulder and then screwed the ring up tight holding it securely, though there was only 1-16 inch margin all around. I then cut notches all around, as shown in Fig. 1, making the width of each notch D equal to the difference in circumference of B and C divided by the number of notches, leaving about 1 inch space E between. The notches were not cut until after the washer was secured to the plunger, so that there would be plenty of leather to prevent the washer from spreading.

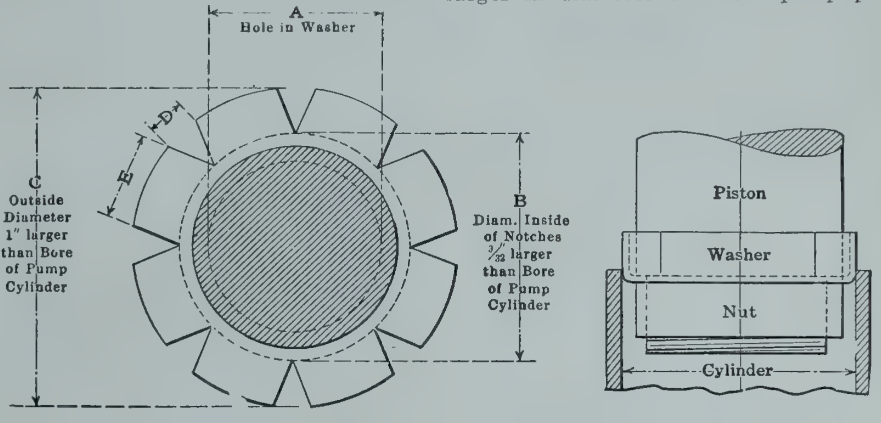

A
Hole in Washer
C
Outside Diameter 1" larger than Bore of Pump Cylinder
D
E
B
Diam. Inside of Notches 3/32 larger than Bore of Pump Cylinder
Piston
Washer
Nut
Cylinder

Fig. 1.—An Emergency Pump Repair—Fig. 2.

When pushed into the pump cylinder after being thoroughly wetted the flat portion curled up slightly closing the notches tightly as in Fig. 2. The best I hoped for the job was that it might answer fairly well for a day or two until I could get a regular cup leather. It has, however, been running for over two months, pumping against 70 feet head of water, and apparently doing as good work as the regular leather ever did, and I am inclined to leave it and see how long it will last. I hope this experience may help someone else in a similar emergency. — American Machinist.

INCRUSTATION IN BOILERS.

By Grant H. Powell.*

Incrustation is a deposit that is formed on the plates and tubes of a boiler; it is caused by impurities in the water that are left behind in the boiler. If the water used in a boiler were perfectly pure there would be, of course, no trouble from incrustation. Unfortunately, however, in passing through the soil, water dissolves certain mineral substances, the most important of which are carbonate of lime, which is the same thing as limestone or marble, and sulphate of lime, which is the same as plaster of Paris. Other substances frequently present in small quantities are chloride of sodium (common salt) and chloride of magnesium. It also often contains many other troublesome substances.

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* Sales manager of Hygienic Laboratories, 11 Colborne St., Toronto.

Carbonate of lime will not dissolve in pure water, but will dissolve in water that contains carbonic-acid gas. It becomes insoluble and is precipitated in the solid form when the water is heated to about 212 degrees, the carbonic-acid gas being driven off by the heat.

Sulphate of lime dissolves readily in cold water, but not in hot water. It precipitates in the solid form when the water is heated to about 290 degrees, corresponding to a gauge pressure of 45 pounds.

Chloride of sodium will not be precipitated by the action of heat unless the water has become saturated with it. Since it generally is present in but very small quantities in fresh water, it will take a very long time for the water in a boiler to become troublesome, and with the ordinary blowing down of a boiler once a week or every two weeks, there is little danger of the water becoming saturated with it. Consequently, it is one of the least troublesome scale-forming substances contained in fresh water.

Chloride of Magnesium is one of the worst impurities in water intended for boilers, for while not dangerous as long as the water is cold, it makes the water corrosive when heated, and when present in large quantities, it becomes dangerously corrosive, attacking the metal of the boiler and rapidly corroding it.

Carbonate of Magnesia and Sulphate of Magnesia are not very troublesome constituents of feedwater.

Organic matter by itself may or may not cause the water to become corrosive, but will often cause foaming.

What scale there is in the boiler is made soft by the compound and can be readily detached by means of a strong stream of cold water.

Earthy matter, like organic matter, is not dissolved in the water, but is in mechanical suspension. It is very objectionable, especially when the earthy matter is clay, and when other scale-forming substances are present, is liable to form a hard scale resembling Portland cement.

Acids, such as sulphuric acid, nitric acid, tannic acid, and acetic acid, are often present in the feedwater. The sulphuric acid is the most dangerous one of these acids, attacking the metal of which the boiler is composed and corroding it very rapidly. The other acids, while not so violent in their action as the sulphuric acid, are also dangerous, and water containing either one should be neutralized when it must be used.

The best advice that I can give is that the engineer secure some reliable compound made up to suit his feedwater after an analysis has been made of the water he uses for his boilers.

It is preferable that the compound should be fed to the feedwater before it enters the boiler, so that it will be thoroughly neutralized before entering the boiler and subjected to heat. When this is done there is very little precipitation takes place. If the boiler is blown about a gauge and a half morning and night under the conditions above mentioned there should be little work left for the engineer when he lays up his boiler for cleaning.

A CENT'S WORTH OF POWER.

One would imagine that very little could be done with one cent's worth of electricity. On the average rate and discount of the ordinary consumer, a cent's worth of electricity will operate a 12-inch fan for 90 minutes.

Will operate a sewing machine motor for three hours.

Will keep a 6-pound electric flat-iron hot for fifteen minutes.

Will make four cups of coffee in an electric coffee percolator.

Will keep an 8-inch disc stove hot for seven minutes, or long enough to cook a steak.

Will operate a luminous radiator for eight minutes.

Will bring to a boil two quarts of water or operate the baby milk-warmer twice.

Will make a Welsh rarebit in an electric chafing dish.

Will operate a 7-inch frying pan for twelve minutes.

Will keep a heating pad hot for two hours.

Will operate an electric griddle for eight minutes.

Will run the electric broiler for six minutes.

Will run a massage machine for nearly four hours.

Will keep the dentist's electric hammer and drill going for 90 minutes.

Will keep the foot-warmer hot for a quarter of an hour.

Will run an electric pianola for one hour.

Will vulcanize a patch on an automobile tire.

Will heat an electric curling iron once a day for two weeks.

Will pump 250 gallons of water 100 feet high.

Will keep a big glue pot hot for an hour.

Will drive the electric clipper while shearing one horse.

Will raise ten tons twelve feet high with an electric crane in less than one minute.

Will brand electrically 150 hams.

POWER EFFICIENCY.

By Arthur D. Little *

Large economies both in the production and transmission of power will be possible when the problems of power efficiency are carefully studied by the engineering chemist, in whose province, rather than in that of the mechanical engineer, many of these problems naturally belong.

The selection of the most efficient coal, and the determination of the conditions necessary for its most efficient combustion are essentially chemical problems. Chemical problems also are those arising in the manufacture of producer and illuminating gas, their utilization in gas engines, the development of power from the waste gases of the blast furnace, the adaptation of conditions to the proper handling and burning of peat, lignite and waste coal, the thermometric exploration of coal piles to forestall spontaneous combustion, smoke abatement, the control and improvement of fireroom conditions by draft regulation, flue gas analysis, temperature measurements and even the placing of firemen on the bonus basis. Taking power plant practice and the conditions of coal purchase as they stand the properly equipped chemist should be able to increase the efficiency of power production from five to thirty per cent.

The analysis of boiler compounds as an end in itself presents little to excite enthusiasm, but when such analyses are made the means of saving $3,600 a year in the power plants of a single company they take on a new and larger aspect, not only in the mind of the chemist but in the mind of the chemist's client.

The distribution of power supplies problems no less directly within the province of the industrial chemist. There are few plants in which the industrial chemist working along legitimate lines cannot save from twenty to sixty per cent. of the entire lubrication account.

Much additional might be said regarding the opportunity before the chemist when any material concerned in power transmission is the subject of his study, whether it be leather, rubber or canvas belting, belt dressings, insulating material, trolley wire, trolley cars or trolley wheels. In every case it is within his power to create new standards of efficiency.

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* Engineering Chemist, Boston.

Correspondence and Discussion on Previous Articles

Discussion is Welcomed on Articles Appearing on the Previous Pages.
We Will Remunerate You for Letters Containing Useful Ideas.

BOILER INSPECTION.

I would like to open a subject that in my humble opinion will be of real benefit to the average engineer, that is, the inspection of boilers and the qualifications of engineers for certificates. There is in this country no government inspection of boilers. My opinion is that there should be in Canada, a uniform standard of boilers and laws should be passed to that effect. We see instances every little while where there is loss of life and property through boilers blowing up. If there was periodical inspection, those boilers that are not safe would be condemned, and not allowed to be used when they were not safe to operate.

For instance, take the boiler that exploded at St. Clements. There was a boiler that was known to be at least 28 years old and how much more nobody seems to know. Likely everybody was dead of old age that had anything to do with installing it. This boiler was wasted away in places until it was not over ½ inch thick, and they had a spring weighted valve that was supposed to open somewhere between 110 and 120 lbs per square inch. The consequence was that it exploded, killing one man and injuring two. It looks to me after reading the particulars of the accident that it killed the wrong man.

There are many instances like this one, where the owner does not know anything about boilers, and he generally manages to pick up a man who calls himself an engineer, who knows about as much as he does himself. Possibly he knows enough to turn on the injector and open the throttle, and then he thinks he is an engineer.

I think The Power House would be doing the engineers and manufacturers of Canada a very great favor if it would use its best endeavor editorially and otherwise to start an agitation for more stringent laws in connection with boiler inspection, and demanding that every engineer applying for a certificate demonstrate that he has the ability and knowledge to operate a steam plant under any circumstances.

W. G. WALTER.

STEAM PRESSURE.

I have read with much interest, Mr. Jones' article in the September issue, and also the numerous discussions on the subject since. Fig. 1 needs little explanation. A indicates the tension on the ¼-inch bolts B.

If the scales register 25 lbs. each, it will take over 50 lbs. pressure exerted by spring X, or exterted in any other way tending to separate C and C^1 to show an increase of tension on bolts B.

This proves that the tension on a bolt caused by a force holding two articles together is not increased by a similar force, tending to separate them.

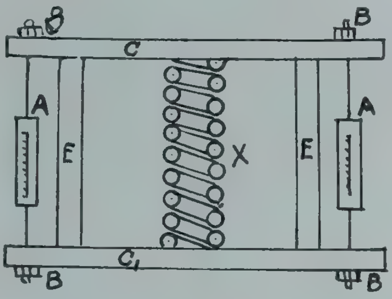


Fig. 1.—Steam Pressure.

Taking Fig. 1 again, let us remove blocks E and spring X, and in place of the blocks insert springs D, as in Fig. 2. Now any increased force tending to separate C and C^1 will move them farther apart, therefore increasing the tension of the bolts, as shown by the scales.

If the scales indicate 25 lbs. tension on the bolts, as in Fig. 1, there is a force of 50 lbs. tending to pull C and C^1 together, but as the springs D hold them apart, they must be exerting a force of 50 lbs., tending to separate C and C^1. Therefore an increase of force of 50 lbs. tending to separate C and C^1 shows an increase of tension on the bolts, but not an increase of 25 lbs. on each scales, as might be expected, as the springs D are being extended and the springs in the scales are being compressed.

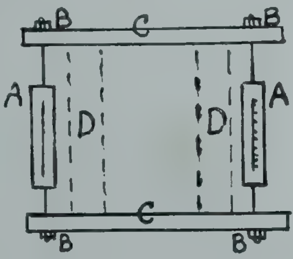


Fig. 2.—Steam Pressure.

The rule that the tension on a bolt caused by a force holding two articles together is not increased by a similar force tending to separate them, will apply to cylinder heads as well as Figs. 1 and 2.

If the tension on the ten studs cause the compression of a gasket, or the iron that makes up the cylinder and head, and such compression exerts a force tending to separate the cover from the cylinder, equal to the tension on the ten studs, then the first lb. pressure in the cylinder will increase the tension on the studs.

If there is not a force already tending to separate the cover from the cylinder, when the 1,000 lbs. tension is on each stud, then there would have to be over 10,000 lbs. pressure against the inside of the cover to increase the tension of the studs.

To prove what I have said about Figs. 1 and 2, is a very easy matter, but with the cylinder! well.

HUGH LANG.

ZINC AS A PREVENTATIVE OF CORROSION.

In view of the discussion in The Power House on this subject the following, taken from Railway and Locomotive Engineering, will be of interest:

A German firm has discovered a new process for rendering iron and steel proof against rust. It was already known that an electrolytic deposit of zinc on the surface of iron and steel is effective against rust, and the use of lead as a coating is also well known. The combination of the two metals has been found very effective by first coating with lead and afterward with electro-zinc. The two combine and form an alloy with a perfect rust-proofing effect.

O. LANG.

A FEW QUERIES.

Would you kindly induce some of your readers to answer through the medium of "The Power House":

1. Power factor when applied to electric motor, also how it is calculated?
2. Peak load?
3. Synchronous?
4. How many different speeds is it possible to develop on a variable speed induction motor? How is the change of speed accomplished?
5. Is there any definite formula for arriving at the steam consumption per horse power of steam pumps?
6. What are the no-load speeds available from a 25 cycle circuit? Is

any rule for computing speeds from various cycle circuits ?

GREENHORN.

ELECTRICAL QUESTIONS.

1. What are primary and secondary wires on a power or lighting line ?
2. What is meant by single phase, two phase and three phase ?
3. What is meant by synchronous motors and what is synchronous ?
4. What is meant by power factor such as 80 per cent. power factor ? How is the power factor of a power or lighting station found ?
5. In speaking of an alternator, what is meant by using a synchronous motor to improve the power factor when operated in connection with induction motors ? What effect has it on the power station ?

R. H. LINTON.

Primary wire is connected to source of power. The secondary wire supplies the current from the transformer.

A polyphase generator produces currents differing symmetrically in phase, such as two-phase currents, in which the terminal voltages on the two currents differ in phase by 90 degrees, or three phase currents in which the terminal voltages on the three circuits differ in phase by 120 degrees.

$I = \frac{W}{E \times P.F.}$ for single-phase circuit.

$I = 0.50 \frac{W}{E \times P.F.}$ for two-phase circuit.

$I = 0.58 \frac{W}{E \times P.F.}$ for three-phase circuit.

I=current in line in amperes; W=energy delivered in watts; E=potential between mains in volts; P.F.=power factor. When power factor cannot be accurately determined it may be assumed as follows. Lighting load with no motors, 0.95; lighting and motors, 0.85; motors only, 0.80.

Synchronous means the occurrence of two events at the same time; caused to act together or occur simultaneously. It is used in telegraphy—in the "step-by-step" system; with alternating current dynamos, where two are used together, it is necessary that they are "synchronized"—i.e., act together, since otherwise the machine may suffer. Motors of the "synchronous type" are so called because they run at the same speed or in a certain proportion to the speed of the generator.

The load factor of a machine plant or system is the ratio of the average power to the maximum power during a certain period of time. The average power is taken over a certain interval of time, such as a day or a year, and the maximum is taken over a short interval of the maximum load within that interval.

In each case the interval of maximum load should be definitely specified. The proper interval is usually dependent upon local conditions and upon the purpose for which load factor is to be determined.

A non-inductive load is a load in which the current is in phase with the voltage across the load.

An inductive load is a load in which the current lags behind the voltage across the load. A load in which the current leads the voltage across the load is sometimes called an anti-inductive load.

The power factor in alternating current circuits or apparatus is the ratio of the electric power in watts to the apparent power in volt-amperes. It may be expressed as follows:

$$\frac{\text{true power}}{\text{apparent power}} = \frac{\text{watts}}{\text{volt amperes}}$$

$$= \frac{\text{energy current}}{\text{total current}} = \frac{\text{energy voltage}}{\text{total voltage}}$$

The reactive factor is the ratio of the wattless volt-amperes (i.e., the product of the wattless component of current by voltage, or wattless component of voltage by current) to the total amperes. It may be expressed as follows:

$$\frac{\text{wattless volt-amperes}}{\text{total volt-amperes}} = \frac{\text{wattless current}}{\text{total current}}$$

$$= \frac{\text{wattless voltage}}{\text{total voltage}}$$

Power factor and reactive factor are related as follows:

If p=power factor, q=reactive factor; then with sine waves of voltage and current,

$$p^2+q^2=1.$$

With distorted waves of voltage and current,

$$p^2+q^2 = \text{or less than } 1.$$

—The EDITOR.

GAS TANK.

What is the lifting power of a reservoir containing 8,000 cu. ft. gas under 5 lbs. pressure, the reservoir weighing 500 lbs. ?

SUBSCRIBER.

DRY KILN.

In the factory where I am employed as engineer we are having some trouble with our dry kiln. The heat runs about 150 to 160 degrees. The lumber dries on the outside, but the centre seems to be a regular bone, or, in other words, is case-hardened on the outside and is green in the centre.

I would like to have the ideas of the readers of The Power House how to remedy this fault.

SUBSCRIBER.

WATER TURBINE TROUBLE.

Having taking your book The Power House in and found it very helpful, a thought struck me, you might be able to help me in my idea and tell me is it workable. Why is this? I have an electric generator running at night, the power to drive same being taken from a water turbine. After 12 o'clock most of the big load is off, and then the machine races. Do you think this could be stopped by putting a valve with a governor attached, to regulate the flow of water and belted to the machine. I don't know of any such ideas in use. I shall be much obliged to obtain answer to my question.

E. FITZGERALD.

BOILER EXPLOSION.

I heartily agree with your idea on boiler explosions. In addition to what you have said, I believe there are more explosions caused by dirty boilers than by any other cause. In the first place, dirt in a boiler prevents the water from getting in contact with the plates. The plates are therefore heated to so high a temperature that they are weakened.

Corrosion is a second cause. On account of corrosion acting along the seams, these parts are greatly weakened before the weakened parts are detected. A third cause is the clogging of water columns, thereby showing the wrong water level.

J. H. HOWNELL.

E. J. Greenstreet, F.R.A.I.C., Cold Storage Architect and Refrigeration Expert, has opened offices in the Imperial Chambers, 32 Adelaide St. east, Toronto. Mr. Greenstreet has supervised instalations in South Africa, South America and Great Britain. In addition he has supervised reports on refrigeration for several governments, including the Canadian Government.

J. F. Vandeleur, of Vandeleur & Nichols, electrical engineers, Toronto, has combined business with pleasure in his trip to England, and when he returns early in the new year he will bride is Miss Owen, of Sheen bride-to-be is Miss Owen, of Sheen Lodge, Richmond Park, Surrey. Miss Owen is a daughter of the late Wm. Owen, of the Foreign Office, and granddaughter of Sir Frederic Owen, the well known archaeologist.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

BICE REGULATOR.

The Bice automatic regulator for feed and belt or steam pumps is a small self-contained brass casting as shown in the accompanying cut, and is easily placed on any steam boiler, stationary, portable, locomotive or marine.

Its purpose is to automatically keep the water at a constant level in the boiler without any attention required when this device is not in use.

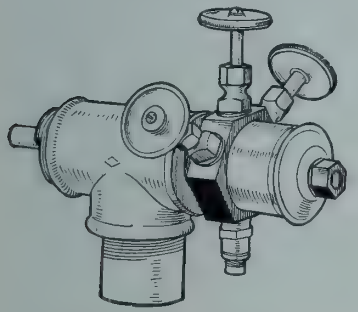
Among the instalations are F. W. Hore & Son, Hamilton, and the Page Wire Fence Co., Walkerville. There are three different arrangements of the regulator.

(1) For one boiler fed with steam pump, place regulator on top of boiler with float in boiler. The float rises as water is pumped into the boiler and cuts off steam. It is therefore a pump and boiler feed regulator.

(2) For a battery of boilers fed with steam pump, the steam passes direct to pump, and water flows through regulator to boiler. The water raises the float and cuts off the passage of water through the regulator. A pump governor is used to take the pressure off pipes.

(3) The regulator is used with a belt driven plunger pump without governor, and lets excessive supply pass through the machine and back to heater.

Machines are tested to 250 lbs. cold water pressure before being placed in service. The Bice regulator is manufactured by the Bice Regulator Co., 9 Greene-Swift Bldg., London, Ont.

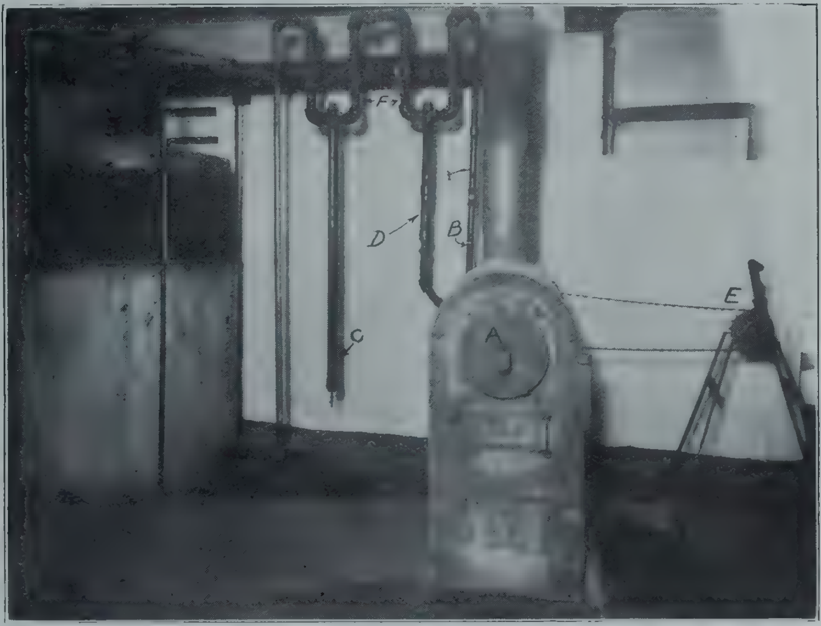


Bice Automatic Regulator.

GAS FROM PEAT.

An interesting demonstration of the manufacture of gas from peat was given in Montreal on December 31st by J. D. Oligny, the inventor of the process used.

The peat is not used in the raw state, but undergoes a preparation by which the capillary structure of the peat fibres is broken down. This operation forms the kernel of Mr. Oligny's patented process, and is rendered necessary by the peculiar capillary properties of peat, which make it very difficult to dry and compress the peat so long as the capillarity is unchanged. These tiny capillary tubes persist in absorbing moisture even after an expensive drying process, but after Mr. Oligny's process the moisture is automatically given off and the difficult pressing and drying operations are dispensed with.



Gas From Peat—the Apparatus.

The process of the gas-making is very simple, as no dryers or scrubbers are necessary. The model apparatus is shown in the accompanying illustration. The gas is made in a revolving metal retort, the charging door of which is shown at A. The gas emerges through the pipe B, and all the fixed gas passes through the pipes F to the gasometer. The condensed volatile matter returns through the condenser D, as a liquid, containing parafine, tar and alcohol. This is reheated and the rest of the gas is evolved. C is a "collector," down which the tar and acetate of lime flows. These by-products of the operation are mixed with the residue left in the retort and made into small briquettes, which make an excellent fuel. The door A will be made to work on hinges to facilitate charging. The retort is revolved by means of a chain E, engaging a sprocket wheel in the rear of the furnace.

In commercial operation the apparatus will be self-contained, i.e., the gas will be used to heat the retort and as power to drive the revolving mechanism.

In the demonstration 3 pounds of peat made 33 cubic feet of gas in 25 minutes, the gasometer beginning to rise before a minute had elapsed after charging. About 23,00 cubic feet of gas is evolved from a ton of prepared peat, at a cost of $4 per ton. The gas, which is non-poisonous, is claimed to give a better light than coal gas in the ratio of 23 to 17, and the making consumes only one-tenth of the time. The Peat Gas & Coke Co. have taken over the patents and already have a franchise to supply the Town of Ville Emard with this peat gas. It is claimed that this gas can economically be used by steel companies and other forging systems, as well as for power purposes, and the cheapness and simplicity of production should appeal to the majority of power users.

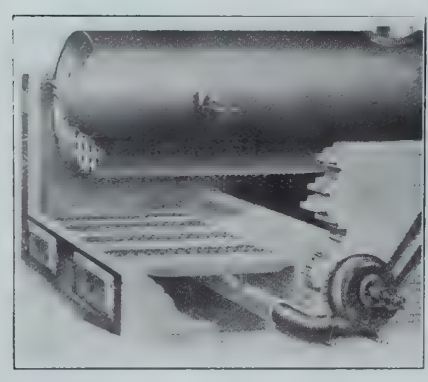
The Peat Gas & Coke Co. have their offices at 52 St. James Street, Montreal.

IMPROVED HOT BLAST GRATE.

In the improved hot blast grate, illustrated herewith the blast openings are distributed in four rows lengthwise along each blast bar. The blast from the outside rows is converging, while that from the inside rows is diverging.

In addition to the blast from these rows of opening, another blast is delivered forward from the tuyeres next to the bridge wall. This forward blast plays an important part, and is one of the distinctive features of our grate. Whereas, in the case of an ordinary grate, the draft has a natural tendency to take the gases and smoke away from the fire up through the smoke stack too quickly for them to be properly consumed, this blast from the tuyeres next to the bridge wall forces back the gases over the fire and supplies oxygen for their thorough combustion.

No change is required in the brickwork of the furnace to put in the grate, and it can be used in either furnaces or ovens, and in any number from one up. It is only necessary to make an opening in the side wall of the ashpit and in the partition walls, if there are any, to allow placing the main blast pipe. The grate is made to fit the furnace. Each blast bar is provided with a cleaning gate underneath. When the bar needs cleaning this gate is opened and the dust is driven out by the action of the blast.



E. Long Improved Hot Blast Grate.

The grate bars are of heavy design. The blast openings are drilled in the Improved Hot Blast Grate Bars. They give good service in sawmills burning sawdust. These grates are manufactured by the E. Long Mfg. Co., Orillia, Ont.

TAURIL PACKING.

A new packing for high pressure jointing has been placed on the Canadian market. Tauril will stand a varying temperature up to 572 degrees F., has a tensile strength of three tons per sq. in., and stands compressive strain of fourteen tons. It is therefore good for steam (dry or superheated), refrigeration plants (ammonia and coal air systems), etc. The Garlock Packing Co., Hamilton, have issued an interesting booklet in regard to it for engineers requiring this class of packing.

FISHER FUEL ECONOMIZER.

A compound has been placed on the market known as Fisher Fuel Economizer, which it is claimed, will effectively ensure compliance with smoke abatement laws and also cut down the consumption of coal.

The substance when applied to coal forms an exceedingly thin film over it and causes the valuable or heat-producing gases to be held in the coal itself, and the coal and gases are consumed together thus preventing the waste of valuable gases.

The reason for practically all the loss is imperfect combustion of the heat-producing elements of the coal.

The elements which make coal valuable as a fuel are:

(1) Fixed or free carbon, well known as charcoal or coke.

(2) Hydro-carbons, such as olefiant gas, tar, pitch, naptha, etc., all of which must become volatilized or passed into the gaseous state by heat before being consumed.

(3) Oxygen and hydrogen.

When heat is applied to coal the volatile hydro-carbons and other gases are driven off, together with the free carbon.

Unless they can unite with sufficient air to furnish the required oxygen and be at once raised to a high temperature, they pass away as unconsumed gases and smoke; but if they are united with the proper amount of air and are heated to a flaming point, they are completely consumed, giving out an intense heat, without smoke.

The Fisher Fuel Economizer has been used in treating coal in power plants and on locomotives. It is found in these cases that in addition to the claim of smoke abatement, the treatment increases the heating power. At the Canada Life Assurance Company's building, Toronto, two boilers of about 50 h.p. each are used for power and heating over a million feet of space. They use run-of-mine soft coal. Without the Economizer it was necessary to fire the boilers two to three times per hour, and use a steam jet each time for six minutes, to abate the smoke nuisance. With the Economizer they now fire the boilers two ro three times per hour and use the steam jet for 1½ to 2 minutes each time, showing a saving of a large amount of coal and steam, with satisfactory results.

In treating coal dissolve 3 lbs. of the compound in 5 gals. of water for each ton of coal. It takes 20 minutes to dissolve, after which stir the solution and sprinkle it over the coal, which it coats; the effect is lasting, and quite efficient for a future time.

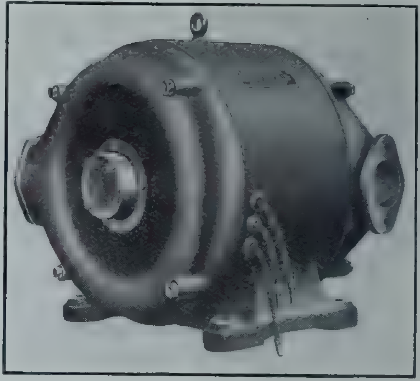
The best results are obtained by immersing the coal and allowing the solution to drain back into a tank. Allow the coal to remain a few minutes before draining, and every piece of coal will be coated. It is also much more economical than sprinkling the coal, which wastes the solution.

The Fisher Fuel Economizer have an office and warehouse at 74 Bay St., Toronto, MacCallum & Harte, 21 John St. south, are the Hamilton agents.

ENCLOSED MOTOR.

The motor illustrated herewith is for use in the foundry or in dirty places. It is a pipe ventilated motor, the cut showing the intake pipe at the back. This pipe is connected with the outside of the building; the other end blows the air into the shop if wished, a fan drawing the air in and forcing it out.

This motor is made for direct or alternating current, in all sizes. It is dust proof, being completely covered by a case. One of the features is that it is run with ball bearings and requires lubrication once in two years. Grease is the lubricant and is inserted by removing the small cap at the end of the bearing. A chimney cooled motor for outside work is built along similar lines.



Enclosed Foundry Motor.

These motors are being placed on the Canadian market by the Lancashire Dynamo & Motor Co., 152-4 Bay St., Toronto. G. E. Mason is manager of the Canadian branch of this company.

NEW BOILER COVERING.

James Higgins, Calgary, has invented and patented a substance for covering steam pipes and boilers that may make him a wealthy man. It is a substitute for asbestos, and though better for the purpose, costs only one-third as much. This substance is not affected by electricity and is tougher and will stand more abuse, these being advantages it has over asbestos. Mr. Higgins has put this substance on the pipes at the C.P.R. depot, and over the boilers in the C.P.R. power house, and the engineer in charge says that since it has been done there has been a saving of 25 p.c. on fuel.

Sucro Gravity Filtration System for Universal Use

May be Applied to Filtration of Water and Other Liquids, such as Gasoline, Oils, Vinegar, Wine, etc., containing Organic Impurities.

The demand for a universal system of gravity filtration, that is, a system applicable to the filtration of all kinds of liquids whether for small or for large uses, has existed for a long time. There are in use, at present, as many systems of filtration as there are purposes to which they are applicable. In other words, there is a system available for every purpose where filtration is necessary. The Sucro system, now being exploited in United States and Canada by the Sucro Filter Co., 42 Broadway, N. Y., is a universal system applicable to a great many uses.

Gravity—which is nature's method—is generally acknowledged to be the ideal filtration pressure. But the large and costly area heretofore necessary in the operation of gravity filtration systems, caused by the fact that these systems could be laid out horizontally only, has, in a great many instances, been one of the chief factors militating against their more widespread use. Artificial pressure filtration is likewise costly in that it not only involves a large initial outlay for apparatus or plant, but likewise means a more delicate, or, at least, a more complicated system than would otherwise be necessary.

The great output of artificial pressure filtration systems as well as that of rapid gravity systems is more than counterbalanced by their consequent decreased filtering efficiency. It is only reasonable to suppose that any filtration system having an unusually high rate of output cannot produce a filtrate of the same purity of that of a system having a considerably lower rate of output.

In rapid filtration systems, coagulants of various kinds are extensively used. In fact, it is upon coagulants that rapid filtration systems depend for their efficiency as the coagulants are, to all intents and purposes, the real filtering bed in that they are employed to catch and hold the bacteria as well as the suspended matter in the water to be filtered. Unless these coagulants are, however, added in exactly the proper proportions, they are likely to exert a harmful influence not only upon the mains conveying the filtrate but upon the consumer as well. In view of this possibility, to say nothing of the expense involved in using coalgulants, it would seem that filtration systems whose efficiency is independent of them are much to be preferred.

The Sucro system originated in Germany and is the result of years of research, experiment and testing of almost every known filtration system spent by experts in the employ of the Sucro Company in attempting to find or devise a practical system of gravity filtration that would be applicable to the filtration of any liquid containing organic impurities. Armies, navies, railroads, municipalities, manufacturing concerns and private users are to-day, and have been for years, employing the Sucro system under every conceivable condition of service and climate. The German government adopted it for the Imperial army, navy and railroads only after the most severe tests and in competition with all other known filtration systems. Siemens & Halske, one of the largest electrical manufacturing concerns in Europe, after a series of searching tests, decided to use the Sucro system exclusively in conjunction

Locomotive Water Tank Supplied With Sucro Combination Aeration and Filtration System.

with their ozone system for destroying bacteria.

The Sucro filtering medium is a lamelle, or cell, consisting of a frame of any suitable size or shape surrounded by a flexible filtering material. A small pipe introduced into the upper part of the lamelle acts as an air vent. The filtering material is produced by fusing chemically pure asbestos cloth and a porcelain-like substance into a homogenous, infrangible, heat and frostproof, and exceedingly durable mass. Each square inch of filtering material contains approximately 195,000 pores.

Impurities cannot enter these pores as only a small percentage of them collects on the outer surface of the filtering material, whence they can be readily removed by a brush. On account of the fact that the liquid to be filtered passes through the lamelle horizontally, most of the impurities immediately sink to the bottom of the tank containing the lamelle. This, together with allowing the filtrate to pass from the inside of the lamelle to the outside, effectually prevents clogging of the pores. The compact form of the lamelle permits of its ready sterilization. No chemicals are used to assist filtration.

The lamelle is designed to occupy a perpendicular position. The number of lamelles forming a filtration system depends entirely upon the output of filtrate required. The ordinary household or office cooler contains but one lamelle. A Sucro municipal, office building, factory, or residence filtration system differs only in that it embraces a larger number of lamelles.

While the average output of the Sucro system is but three gallons per hour per square foot of filtering area, the perpendicular position of the filtering lamelles makes possible a very large filtering area within a limited compass. Thus, the possibility of adapting the Sucro system to the area available for filtration is at once apparent. The Sucro system may be arranged in tiers instead of merely horizontally.

One of the chief advantages of the Sucro system lies in the fact that every one of its parts is visible and easy of access for cleaning. In small systems cleaning is done by hand. In the larger systems, cleaning is done automatically, by means of long revolving brushes, operated by an electric motor and suspended from a movable platform, somewhat of the nature of a crane, passing over the surfaces of the lamelles. In such cases, a jet of water or steam precedes and follows the path of the brushes and assists in washing the impurities from the faces of the lamelles. The cleaning mechanism is designed to simultaneously brush the front and back surfaces of two lamelles.

An interesting test, demonstrating the Sucro system's efficiency in clarifying discolored water, was performed at the recent convention of the American Water Works Association at Milwaukee. The tank containing the lamelle was filled with water to which a considerable quantity of wash blue had been added, dyeing the water a deep blue. The filtrate, however, emerged colorless. The exploiters of the Sucro system claim that theirs is the only commercial system that can clarify water discolored in the aforementioned manner.

The Sucro system may be applied to :

1. The filtration of water for cities, towns, villages, summer resorts, and
2. Hotels, apartment houses, private residences, hospitals, office buildings, laundries, steam boilers, paper mills, bathing establishments, mineral water factories, breweries, and distilleries, army and contractors' wagons ;
3. Combination water coolers and filters for families, offices, factories and railroad stations ;
4. The filtration of oils, vinegars, wines, spirits, gasolene and other liquids.

CATALOGUES.

LUBRICATOR—Pamphlet 210 describes in detail style "C" single connection lubricator made by the Detroit Lubricator Co., Detroit, giving directions for operating, prices, etc.

ELECTRICITY—The D. Van Nostrand Co., 23 Murray St., New York, have issued a 96 page catalogue dealing with electricity and its application. Books dealing with every phase of the subject, are listed.

GAS ENGINES—An illustrated booklet from The Empire Engineering Co., Caxton House, Westminster, S.W., Eng., describes fully the Empire Engine made in two sizes 1½ and 3 h.p. using petrol, gas or ordinary paraffin oil or kerosene.

STEAM SPECIALTIES—The Wright Mfg. Co., Detroit, in their catalogue No. 11 describe steam traps, water columns, exhaust heads, etc., manufactured by them. The catalogue, printed on coated paper, contains 43 pages of illustrated descriptions and useful information.

WATER TREATMENT—A handsome catalogue from the Dearborn Drug & Chemical Works, Chicago, deals with the company's works and laboratories giving methods for treatment of feedwater in marine, locomotive and stationary boilers.

PIPE AND BOILER INSULATION—The H. W. Johns-Manville Co., 100 William St., New York, and 85-87 Wellington St., Toronto, have issued a neat booklet dealing with the insulation of pipes and boilers. Various forms of insulating material is given including tables of costs, etc.

ARC LAMPS—A paper on "Recent Types of Arc Lamps and Their Operation," by C. E. Stephens, read recently before the National Electric Light Association 1909, has been issued as circular 1506 by the Westinghouse Electric & Mfg. Co., Pittsburg. The article, which is fully illustrated, deals with the subject fully and is worthy of being perused by everyone interested in arc lamps.

STEAM SPECIALTIES—Catalogue 20 from Watson & McDaniel Co., 146 North Seventh St., Philadelphia, deals with McDaniel steam traps, Chapman steam traps, Columbia expansion traps, floats, exhaust pipe heads, reducing valves separators, etc. Something new is the Watson pilot operated reducing valve and the Watson air and gas reducing valve. Prices are included in the catalogue.

MOTOR-GENERATOR SETS—Motor-Generator sets are important factors in the distribution of electrical energy on the modern power system. No power station could be profitably equipped with the assortment of machinery which would be necessary to supply electric current to meet the varied requirements of a modern power system. The current produced by the central power station must be adapted to the service of the greatest number. In order to supply the needs of the minority, transforming device of some sort must be used. The functions of the motor-generator set and the methods of choosing the motor-generator best adapted for each condition have been clearly outlined in Bulletin No. 116, published by the Crocker-Wheeler Company, of Ampere, N. J. There is also a considerable amount of interesting engineering information in this bulletin. It will be gladly sent to any address on request.

GROWING MORE INTERESTING.

Fort William, Nov. 20th, 1909

The Editor, "The Power House,"
10 Front Street East, Toronto, Ont.

Dear Sir,—Allow me to thank you for the fight you are waging for a Uniform Boiler Law, also for the graded certificates for engineers. I do hope we will get that when the Parliament of this Province meets again. Let the good work go on. I am pleased to see "The Power House" growing more interesting each number, and I think it is up to the boys to make it more so yet.

FRED NAGLE.

1910 CALENDARS.

The Kerr Engine Co., Walkerville, have issued to their customers a decidedly handsome calendar for 1910, it being a copy of Wilm. Steelink's celebrated painting "The Shepherdess and Her Flock," the view being a Dutch pastoral scene of beautiful coloring. It is in hanger form 15 x 22 inches in size and would do credit to any hardware office—or home.

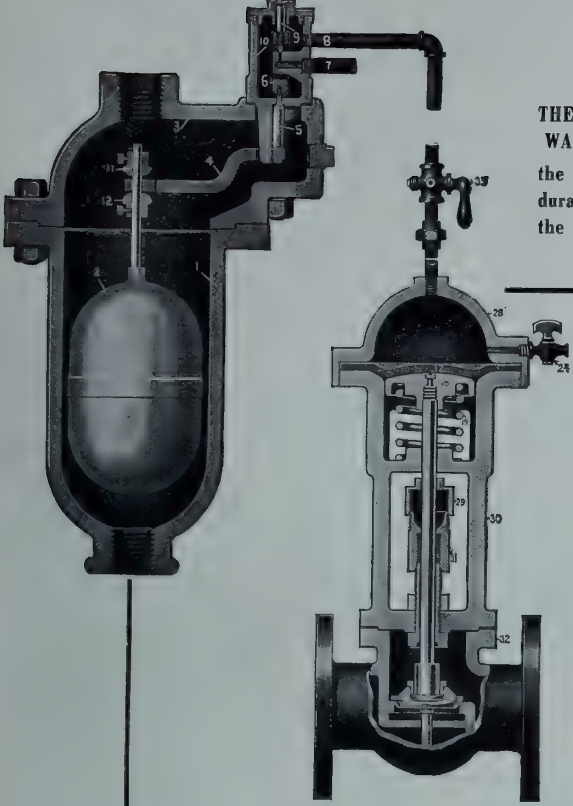
The Ontario Lantern & Lamp Co., Hamilton, for their 1910 calendar, have an exceedingly handsome wall hanger about 36 x 20 inches in size, showing a hall and staircase lighted by tungsten electric lamps, one of the "Kolloid-Wolfram" lamp enclosures, lying on the floor, this line being produced by the Canadian Tungsten Lamp Co., Hamilton, with which the Ontario Lantern & Lamp Company is associated. The design is especially prepared and draws attention effectively to the makers of "Banner" cold blast lanterns.

BOOK OF ENGINEERING SUBJECTS.

The Magnolia Metal Co., 113-115 Bank St., New York, are making on page 55 of this issue of The Power House, a special offer to engineers and mechanics, to furnish a 650 page Practical Engineers' Pocket Book for 40 cts., prepaid.

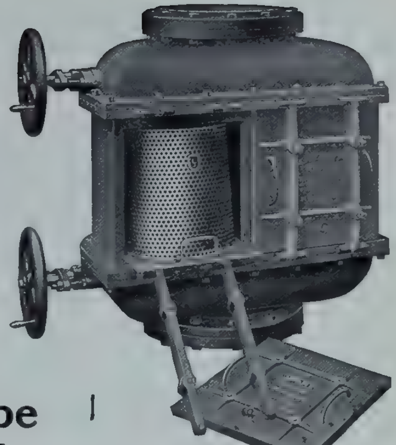
This book treats on over two thousand mechanical and engineering subjects and is one of the most complete and up-to-date works of the kind ever issued.—Engineers who have had previous copies of this book consider it invaluable as a work of ready and accurate reference.

Those who wish to secure a copy of this book are asked to notify the company promptly at their Montreal address, and the company will advise all of those who make application for these books as soon as it is ready to be sent out from England, when the price of the book can be remitted.



THE "LIBERTY" FEED WATER REGULATOR

the most reliable and durable regulator on the market.



THE "LIBERTY" TWIN STRAINER

Constant service. While one basket-strainer is being cleaned, water continues through the other.

The "Liberty" Catalog should be in every power house.

It is quite possible to operate a power plant to-day in the same way and with the same appliances as our grandfathers used in the middle of the last century.

It would be interesting to do so, perhaps—but it would be the reverse of good business.

The modern way is to take advantage of

"LIBERTY"

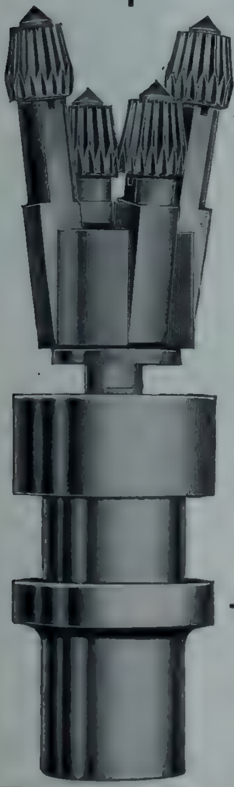
Power Plant Appliances

Their use results in perfect safety, combined with the greatest efficiency and economy.

Our catalog contains pictures and descriptions of the latest and most practical appliances ever discovered for increasing power plant efficiency and economy. You would be greatly interested by reading it.

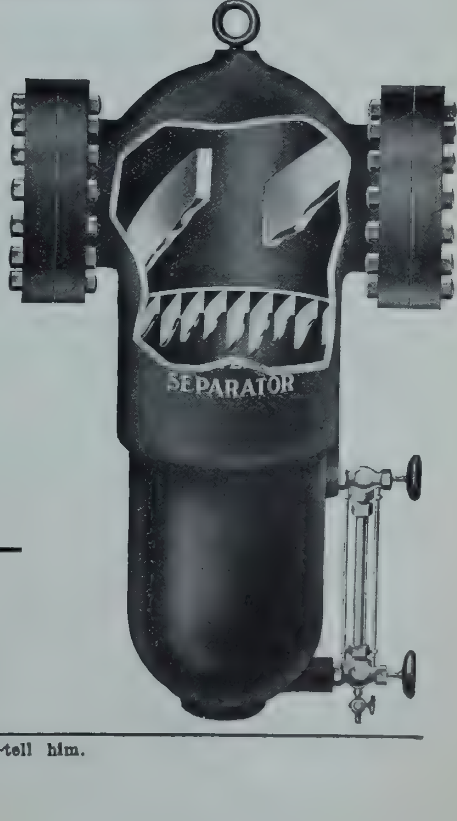
Ask us to mail you a copy.

LIBERTY
Manufacturing Company
6902 Susquehanna Street, PITTSBURG, PA.



THE "LIBERTY CYCLONE" TUBE CLEANER

breaks up and removes the heaviest scale in less time and with less trouble than any other tube-cleaner made



THE "LIBERTY-GREENAWAY" STEAM SEPARATOR

The patent of this Separator was purchased by us recently, because this is the one perfect steam separator. No other make can compare with it.

POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

Quebec Power Schemes.

MONTREAL—The by-law submitted to the property holders on December 21st asking permission to spend $2,000,000 to establish a municipal lighting plant was carried.

QUEBEC—Rodolphe Forget makes the following official statement in regard to the Quebec Ry., Light, Heat & Power Co.: The following companies will be included in the merger: The Quebec Railway, Light & Power Co., the Quebec Jacques Cartier Electric Co., the Canadian Electric Light Co., the Quebec Gas Co., and the Frontenac Gas Co. The new company has an authorized capital of $10,000,000 of stock and $10,000,000 of bonds.

Ontario Power Schemes.

AMHERSTBURG—Natural gas by-law carried, also $20,000 new school by-law.

AYLMER—The town council has decided to rebuild its water and light plant, destroyed in the explosion six weeks ago, and will instal steam-driven machinery.

BELLEVILLE—A by-law was carried authorizing a lighting contract between the Trenton Electric & Water Co. and Belleville. The agreement calls for thirty-seven 2,000 c.p. electric arc lights and 235 incandescents, the lamps to burn every night from sunset to half hour before sunrise. The price for arc lights to be $50 and for incandescents $10 a year. The company also agrees to light city buildings at 8 cents per k.w. or at a flat rate of $2 for each 16 c.p. lamp and to supply citizens, on meter, at 00 cents per k.w. with 20 per cent. discount.

BRAMPTON—Hydro-Electric Power and Power Commission by-laws to raise $40,000 for distributing plant carried.

BRIDGEBURG—Ratepayers have passed by-law granting to Canadian Niagara Power Co., privilege of bringing electric energy into the town.

CAMPELLFORD—By-law to appoint an electric light and waterworks commission carried.

COLLINGWOOD—The Morril Shipyard by-law was carried.

DURHAM—By-law to guarantee the debentures of the McGowan Milling Co., for $15,000 carried.

DUNDAS—By-law authorizing contract with Hydro-Electric Power Commission carried.

HAMILTON—By-law to raise $200,000 for good roads carried.

INGERSOLL—By-law to raise $30,000 for the erection of an electrical distribution plant was defeated.

KINGSTON—By-law carried to purchase a new fire engine and also one confirming an agreement between the city and the Trenton Electric & Water Power Co., for a franchise to light the city for three or five years.

MOUNT FOREST—By-law to aid Leslie's factory carried.

NAPANEE—Waterworks by-law carried.

NORWICH—Money was voted for Hydro-Electric power plant.

NIAGARA FALLS—Additions to the Canadian Niagara Power Co. will be made amounting to $404,285.

OTTAWA—By-law carried to provide a civic publicity department, to establish a civic incinerator and to renew the franchise to the Metropolitan Power Company, giving them the right to sell power in the city.

PETERBORO—By-law carried to give a 30 year non-exclusive franchise to the Peterboro Light & Power Co.

PARRY SOUND—By-laws carried to lend $50,000 to the Union Iron Works for the establishment of an ironworking plant and to grant a bonus of $10,000 for the erection of an ethyl alcohol plant.

PORT DOVER—Ratepayers voted in favor of granting free site and $10,000 to Widespread Implement Works.

PORT ARTHUR—Hydro-Electric by-law carried. Conmee power by-law was defeated.

PORT DALHOUSIE—By-law granting fixed assessment to the Maple Leaf Rubber Co., was approved by the ratepayers.

PRESTON—The Canadian Westinghouse and Kilmer & Pullen, agents, General Electric Co., Sweden, McKinnon Building, Toronto, have been awarded the contract by Mr. Yeates, Hydro-Electric engineer for Niagara power distribution. These contracts to be awarded only on the condition that the money by-law to grant the $18,000 necessary is carried. Voting takes place at an early date.

PRESCOTT—By-law to raise $5,000 for the extension of sewerage, and one to grant various inducements, such as exemption from taxation and small cash bonus towards bringing the Ogdensburg soda pulp factory to locate in the town were carried.

SAULT STE. MARIE—Sewer by-law carried.

SMITH'S FALLS—By-law to raise $46,000 for a new Collegiate Institute and $1,600 to buy a water power for pumping station, carried.

ST. THOMAS—By-law defeated to raise $25,000 for street railway improvements.

STRATFORD—By-law to raise $108,000 for purchase of electric light plant was defeated.

TRENTON—Hendricks Canadian Foods, Ltd., by-law carried.

TORONTO—The by-laws to appropriate $320,000 for new Exhibition buildings and $262,000 for fire-halls and police stations were carried.

THAMESVILLE—By-law to raise $10,000 for waterworks carried.

WINDSOR—Natural gas by-law carried.

WINGHAM—Water, gas and sewer by-laws carried.

Manitoba Power Schemes.

KILLARNEY—A $3,000 heating plant for the town hall is being considered.

ST. BONIFACE—A by-law to raise $200,000 for the construction of a sewer 7 feet in diameter and 1½ mile in length, to cost $200,000, will be submitted to the ratepayers.

Alberta Power Schemes.

EDMONTON—On November 15th, the new Belliss and Morcom engine was put into service and by the time we go to press the two new Robb-Armstrong engines will be under steam. These additional units will give the municipality enough power for forty cars. This street railway service is a municipal enterprise and for the last year trouble has been experienced from lack of power. The initial performance of the new equipment was fully up to expectations and there is not much danger of dissatisfaction from lack of power in the future.

LETHBRIDGE—The power house of the electric lighting plant for the city was entirely destroyed by fire on Jan. 1st, 1910.

British Columbia Power Schemes.

NELSON—Nelson has added a new 1,850 h.p. wheel and 12,000 volt generator to its lighting plant. The generator is the Allis-Chalmers-Bullock type, 1,000 k.w., 3-phase, 60-cycle, 180 r.p.m.

NEW WESTMINSTER—Tenders have been received for the proposed new incinerator. Richard Taunton, of Winnipeg, agent for the Heenan & Froude patent incinerator, made in Manchester, England, gave three or four pricec for different varieties of the machines. Another bid was for $18,168. Its incinerator had a capacity of fifty tons every twenty-four hours. Alderman J. Carter Smith and City Engineer Blackman were appointed to see Mr. Booth, who has charge of the Vancouver plant, to look over the situation and obtain his advice on means of disposal of the city's garbage.

PRINCE RUPERT—The Board of Trade is agitating the installation of a civic lighting plant. It is expected that the Columbia Tie & Timber Company's sawmill at Seal Harbor will be rebuilt and a larger electric lighting plant installed in connection with it to furnish light to the city.

VERNON—Council have endorsed scheme for an electric railroad and the supplying of power and light which E. G. Warren, of Coteau Power Co., presented, involving $2,000,000 expenditure.

Power Supply Markets

MONTREAL.

Inventories are the order of the day at present and reports indicate that the great majority of these show that firms dealing in power plant supplies have had a good year. If we confine this statement to the last six months of the old year the qualification would be "very" good. Business in these lines has assumed a a steady, strong tone and the outlook for 1910 is very promising. There are several considerations upon which this optiimistic view may be based. There are contemplated improvements to the Montreal harbor upon which a million and a half will be spent; the call for tenders on the equipment of the new Grand Trunk Pacific shops in Winnipeg will be out in the near future; the railway building and buying that is contemplated for the coming year; the probability of the commencement of the Georgian Bay canal; all these huge undertakings, when under full swing, will have a tremendous influence for stimulation of both the machinery market and the power supply markets.

The prices on such articles as brass valves and other articles of brass used in power plants, are on the upward move. This is occasioned chiefly by the recent activity in the price of tin which has been going up for some time past. In some quarters the rise in valves has been set at 5 per cent.

MECHANICAL RUBBER GOODS.—Business is very fair. Inventories show a good year last year with the best part at the end. The price of crude rubber still holds around the $2.00 mark although it was recently down to $1.73. This drop in price might be said to have been a bait set by the rubber brokers to see whether the manufacturers were sincere when they decided not to purchase. At this tempting price, however, enough orders were placed to send the price back to the higher level quoted above. With the steady gain in strength of the cultivated rubber plantations a drop to $1.00 by the end of the year or at least to $1.25 would not be a very great surprise. Rubber and cotton fabrics are in line for a rise owing to the rise in the cotton side of the combination. Rubber hose however, is probably selling lower here than in the U. S.

LUBRICATING OILS—The demand is steady with fair amount of orders but already provision is being made to supply a looked for increase in trade with the advent of spring. Prices show no change as follows :—High grade cylinder oils (imp. gal.), 60c. to 80c. ; engine oils, 30c. to 60c. ; machine and dynamo oils, 30c. to 45c. ; shafting oils 25. to 40c. ; engine greases (per lb.) 6 to 12c.

BOILER TUBES.—Reports are better in this line and the market is stiffening up very satisfactorily. Prices on stock goods are the same but on mill orders they show an increase of from 5 to 15 per cent. This increase will probably not be long in showing in the prices of stock goods. Deliveries still run as far as three months and heavy premiums are being paid in some quarters for short deliveries.

Prices for boiler tubes (stock) are :—2-in. tubes (per 100 feet), $8.50 to $8.80 ; 2½-in., $10.25 to $10.80 ; 3-in., $11.75 to $12.35 ; 3½-in., $13.50 to $14.50 ; 4-in., $18.50 to $19.50.

In last month's report the Belliss and Morcom engine mentioned is the new one which they have installed in the Westmount Power Plant.

TORONTO.

The increase in business is shown by the revenue increases. For December 1909 the revenue was $8,733,571, an increase of $1,550,026 which figures out at about twenty per cent. over the same period of 1908. The business outlook for 1910 is excellent and manufacturers of power lines are very optimistic in regard to future business.

Several openings are in sight in Western Ontario. The Hydro-Electric lines are progressing favorably and when it nears completion the United Municipalities will have some large orders to place.

One of the largest instalations at the present time is the power plant of the Simcoe Railway & Power Co. Their power plant, 27 miles from Midland is ready for the equipment. The railway construction will follow and there will be a great quantity of supplies required.

BOILERS.—Manufacturers report a busy season. During December representatives of the several provincial governments met at Regina, Sask., and it is expected that the result of the conference will be uniform boiler laws which will assist boiler manufacture.

BOILER TUBES.—Lap welded steel per 100 ft., 2-in., $8.50 to $8.75 ; 2¼-inch, $10 to $10.75 ; 2½-inch, $10.75 ; 3-inch, $12 ; 3½-inch, $14, and 4-inch, $18.50 to $19.

COAL.—Retail price for Pennsylvania hard, $6.75 net. This price applies to grate, egg, stove and chestnut ; pea coal is $5.75. These are cash.

LEATHER BELTING.—There is a big demand for leather belting at the present time. The prices for hides are stiffening. Market reports show that manufacturers of leather belting are purchasing first quality butts in large quantities.

MECHANICAL RUBBER GOODS.—Trading in crude rubber is quiet, but values are unchanged and firm in sympathy with conditions in primary markets. The situation at both Manaos and Para is strong and prices have an advancing tendency. Stocks at the former place in first hands are very small and holders are firm in their views. Advances here are not unlooked for, as the equivalent of prices at Manaos are higher than those ruling here.

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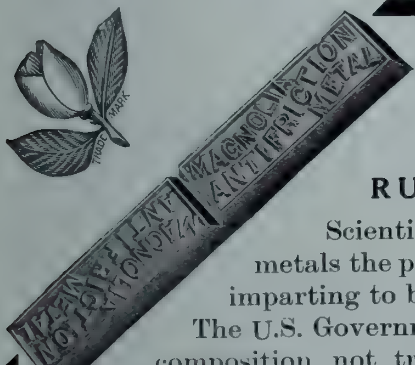

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In one instance I ran a Magnolia Bearing for some weeks under a pressure of **two tons per square inch** at a surface velocity of 250 feet per minute, the temperature being maintained at 130° Fahr. by circulating water through the center of the shaft. After the run the surface was perfect, although the lubrication had been very meagre, viz.: 0.02 lbs. of oil on a pad weighing 0.02 lbs. The pad was oiled every day to make up for the loss.

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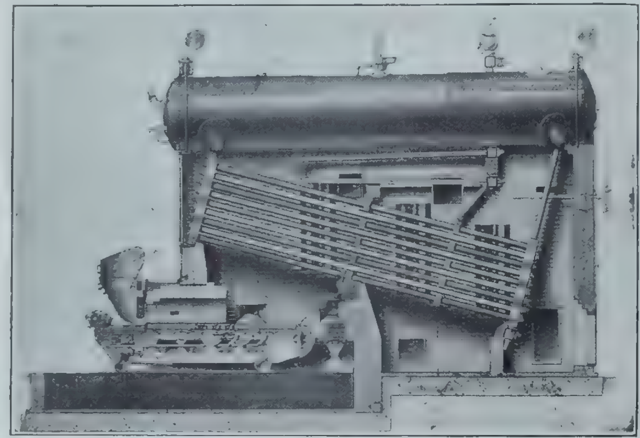

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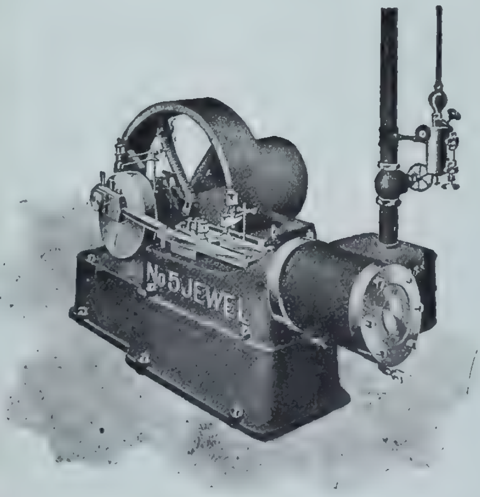

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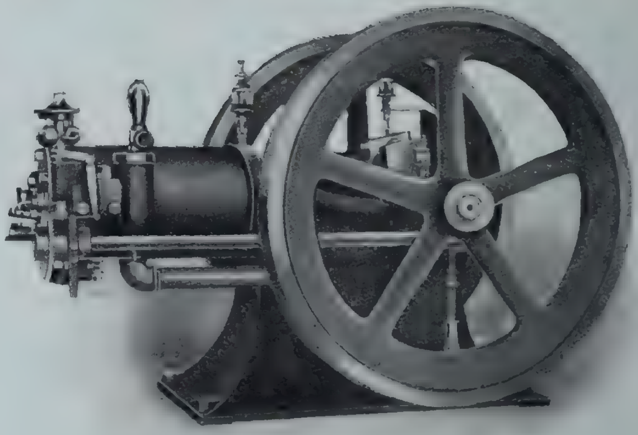

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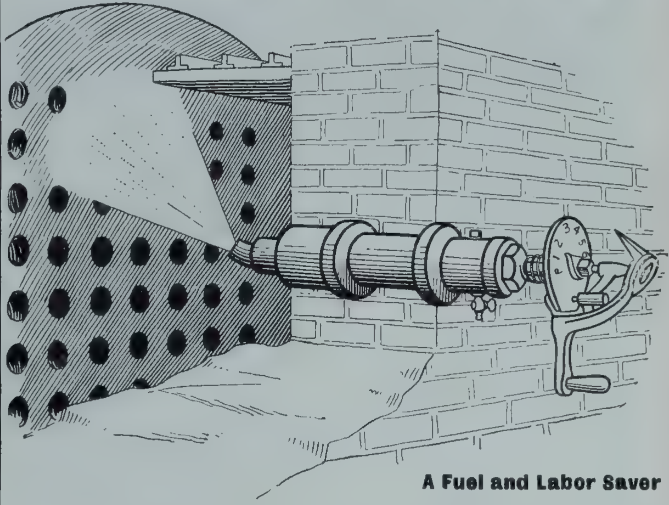

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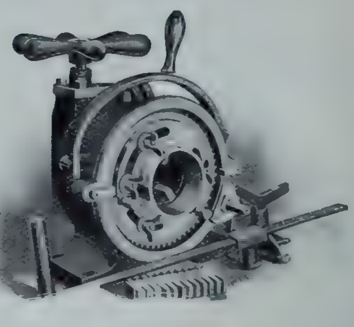

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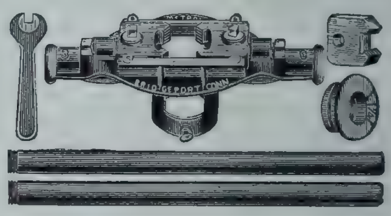

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BY HOWARD M. POST

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Now just listen to a few thoughts I want to put into your minds, and I intend to let you have them straight from the shoulder, too.

We are spending a good many thousands of dollars on space in costly publications—because we have faith in our plans.

We have proved to ourselves what a strong argument on our machines, effectively displayed, will do.

If our advertising hadn't brought results—if the best judgment of our organization didn't tell us that it would *continue* to bring results—we certainly wouldn't spend another dollar of our big appropriation on it. So it is *not a fad* nor a fancy with us. It is *business*—business that pays.

Now here is where it interests each one of you. Our advertising campaign will succeed—but it won't succeed half so well as it can, without your co-operation. By co-operation we mean your *personal enthusiasm*, following up every hit our printed argument makes, and every opportunity for a sale it creates.

Our advertisements are constantly reaching the eyes of millions of readers. A large number of people in your trade territory are among those millions — more perhaps than you imagine. *Some* of these people are going to buy *our machines.* They will, just as surely as the sun shines, because they've got to have these things.

They will be *somebody's* customers. Why not yours?

Did it ever occur to you that our advertisement becomes *your* advertisement when it circulates in your trade teritory—yours just as much as if you had designed it, written it, placed it and paid for it?

It talks to the reader about something *you* have to sell. *You* are the nearest agent that can supply him. If he thinks of you in connection with the article he wants, isn't he going to *look you up?*

If he needs a machine in our line and knows *you* handle them, he has a special reason for wanting to see you. We have told him over and over in our advertisements that our machines will save him 25 to 60 per cent. on operating expenses. We have told him so often that it is bound to "soak in" sooner or later.

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Let them know it. Drive the fact home in whatever way seems most effective to you, but *drive it home.*

We want you to look over our advertisements and tell us what you think of them. We are deeply interested in this matter. As we said, we are spending a lot of money on it, and we want you to get all you can out of it.

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The Blower has been running several months with but little intermission, and has given us no trouble at all.

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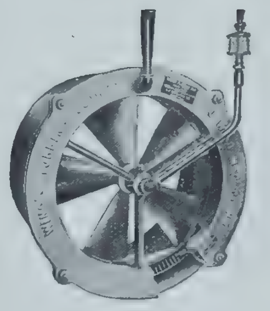

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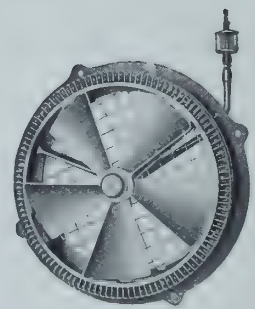

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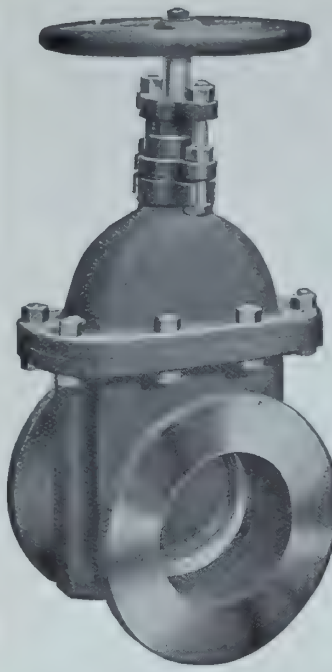

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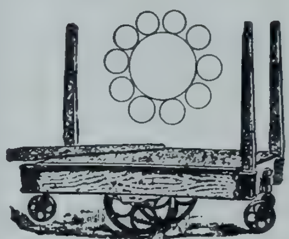

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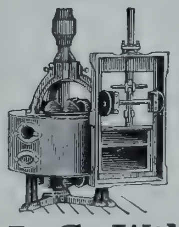

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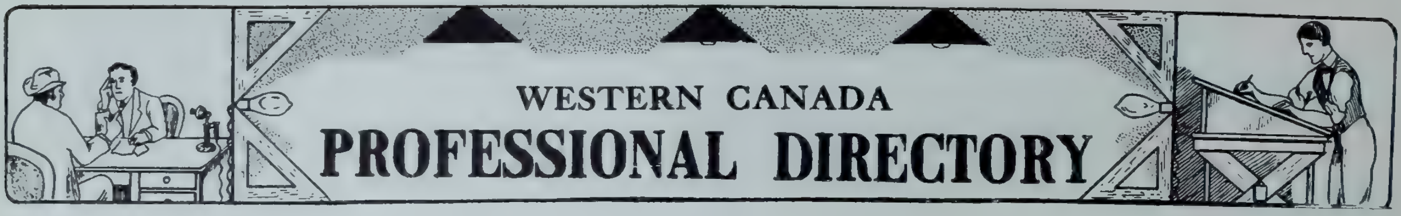

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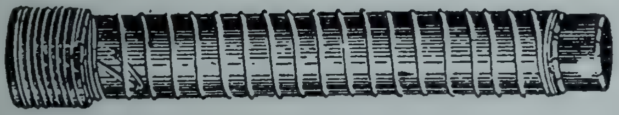

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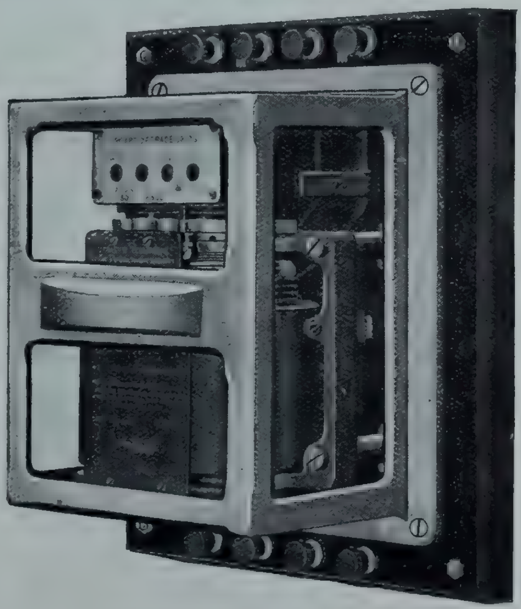

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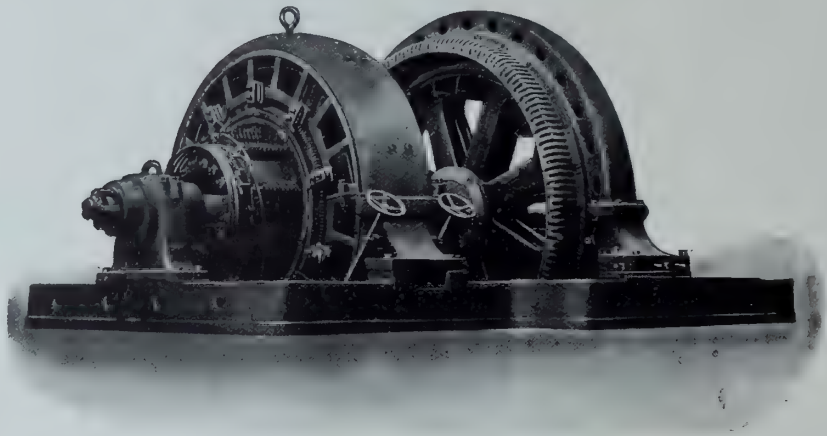

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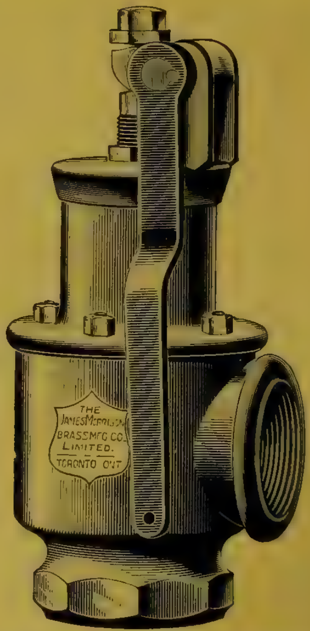
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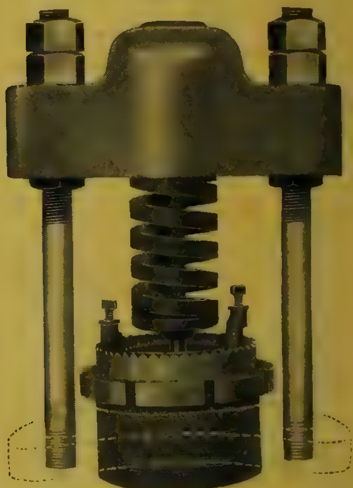

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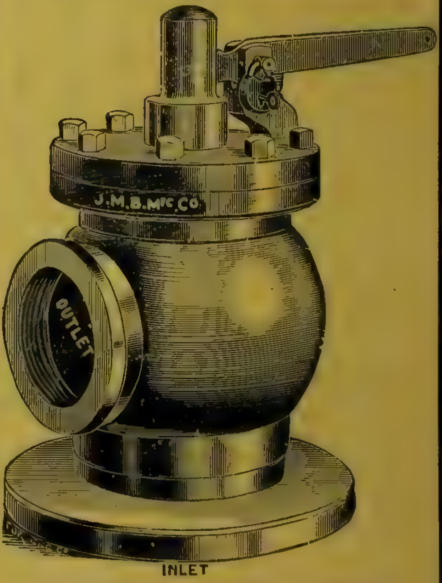

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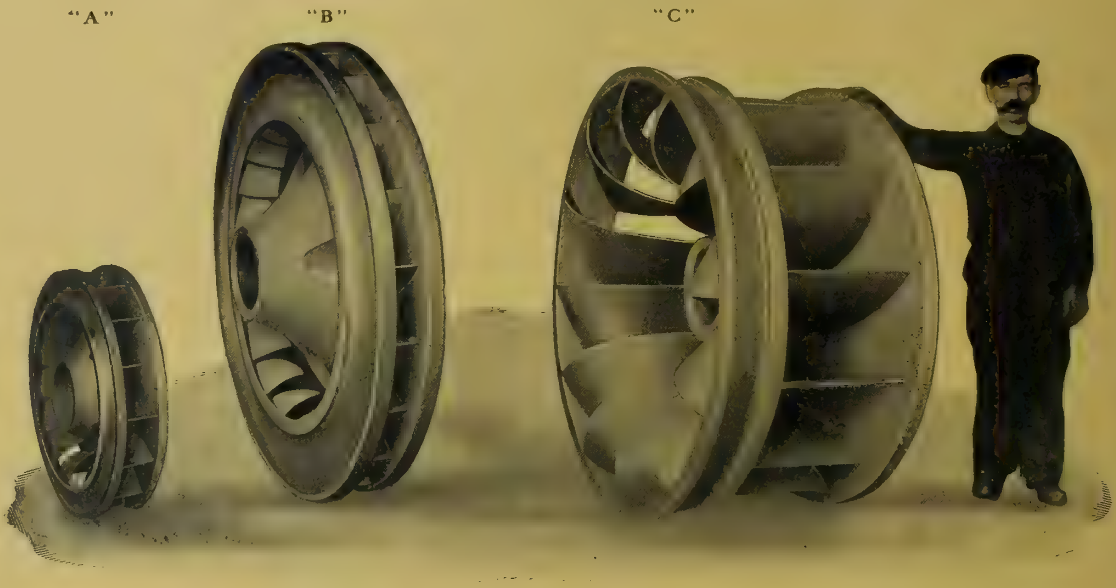

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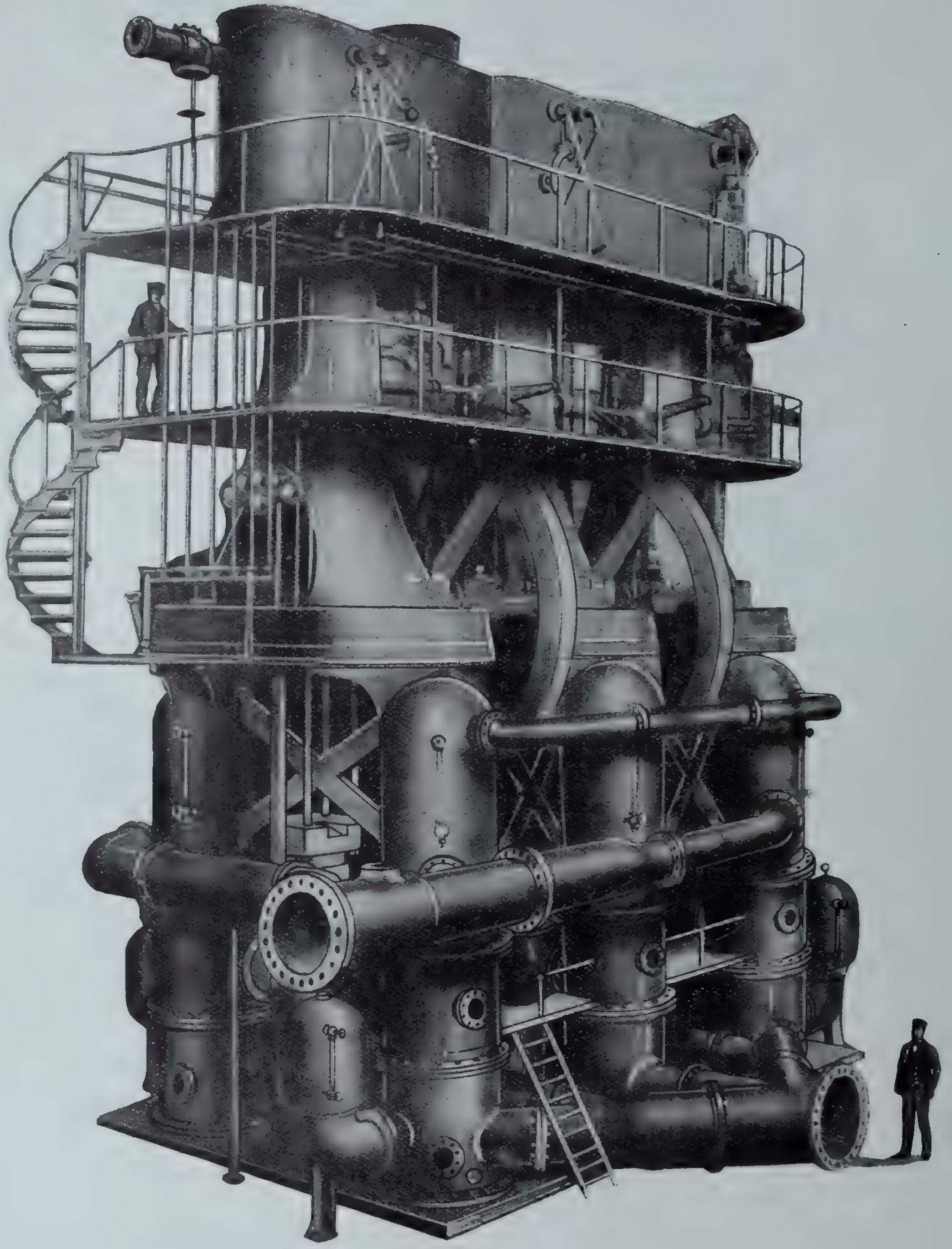

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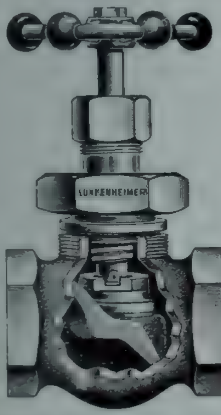

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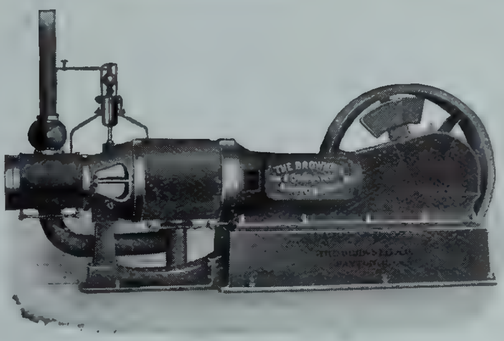

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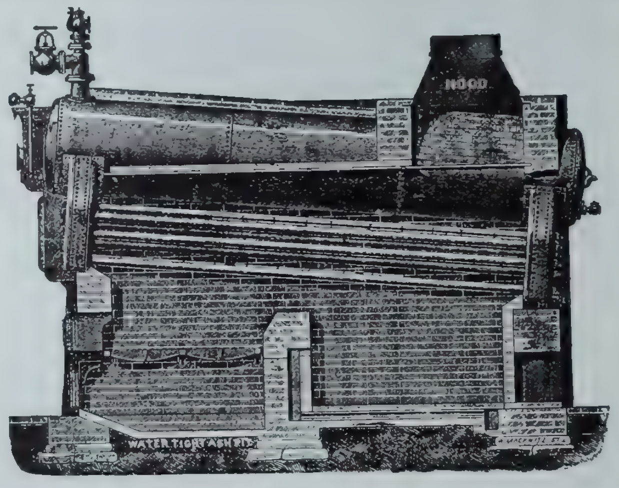

Fig. 1—Heine Boiler and Setting

Every tube and plate of the HEINE BOILER is subjected to bending, hammering, chemical and other tests of the utmost severity before it is allowed to form an integral part thereof, and, moreover, the whole boiler is completely set up and tested before shipment.

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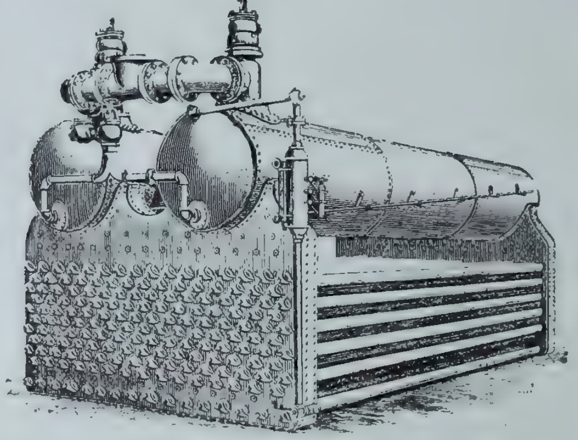

Fig. 2.–The Heine Boiler Without Brick Setting

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It is constructed so as best to absorb and transmit heat, and arranged so that the heat will most easily reach it.

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It precipitates and discharges all scale and mud.

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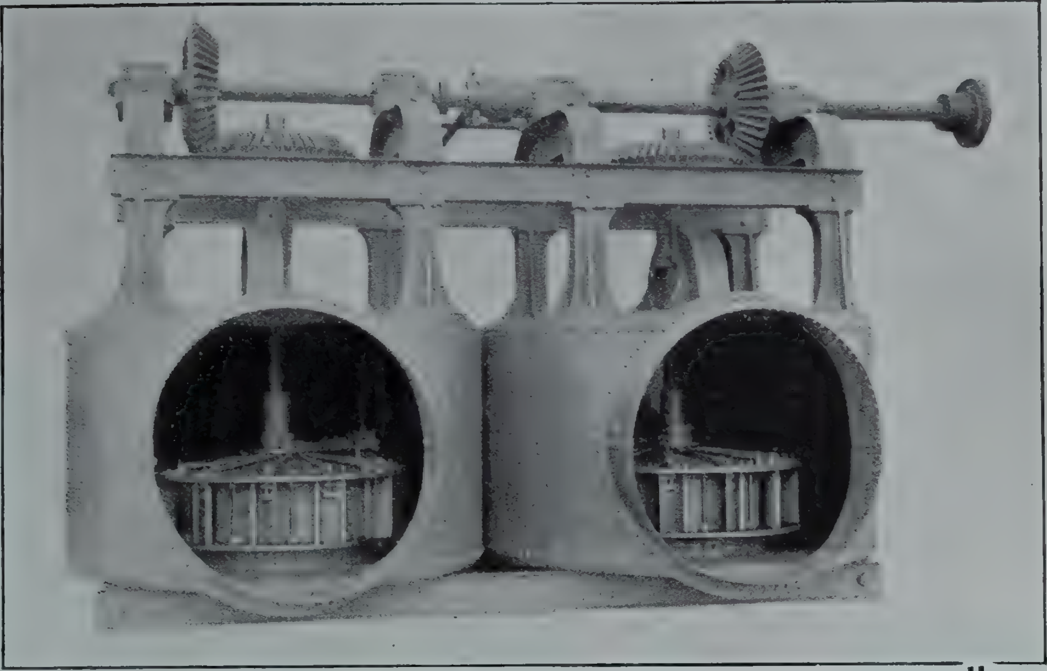

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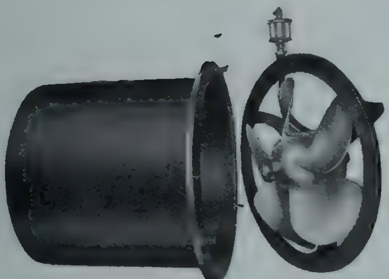

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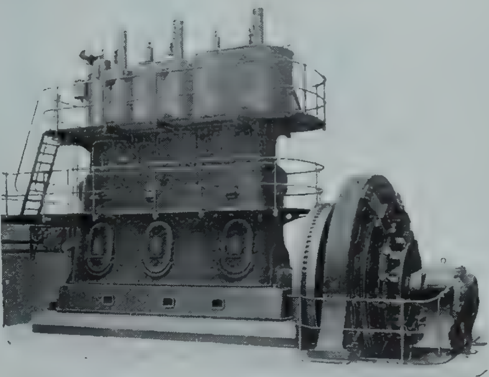

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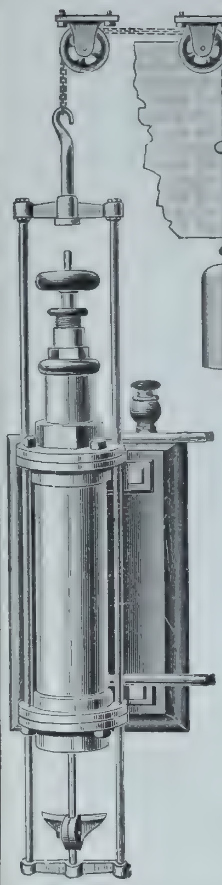

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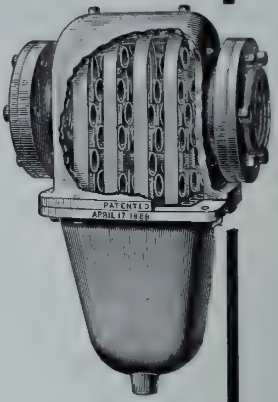

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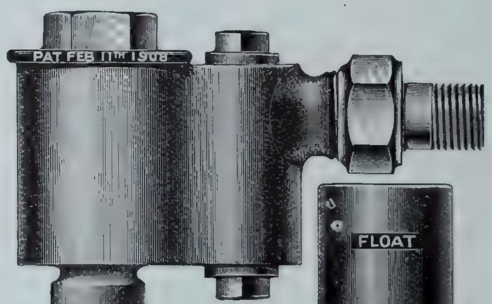

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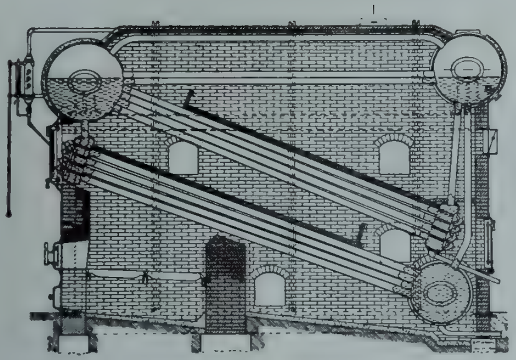

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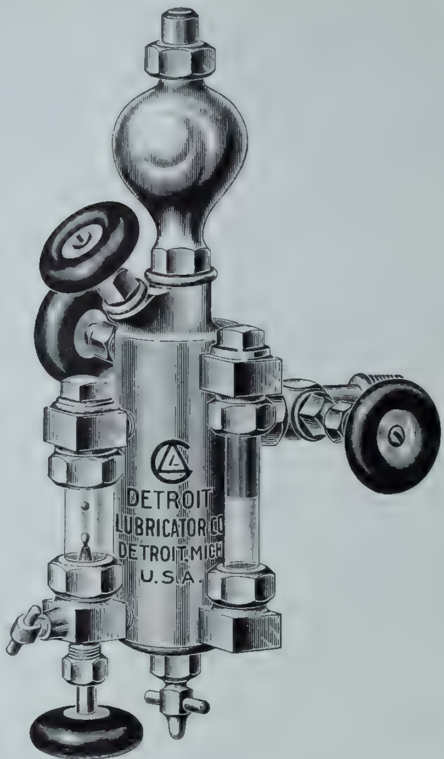

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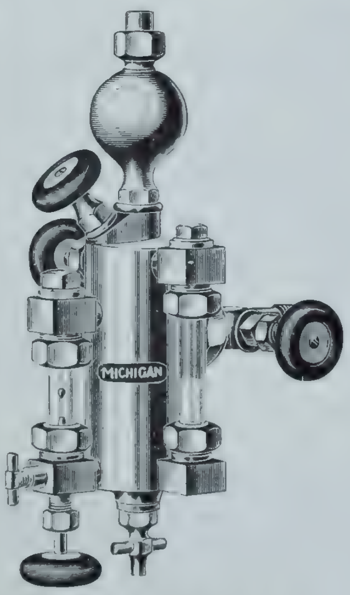

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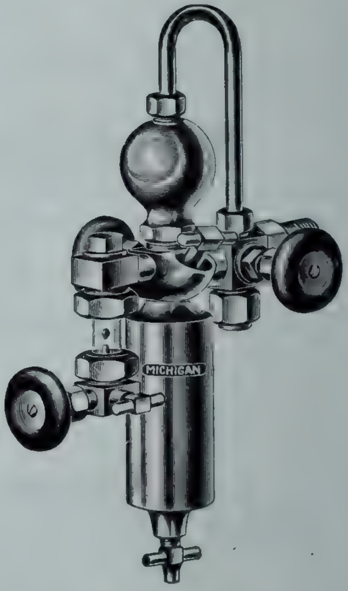

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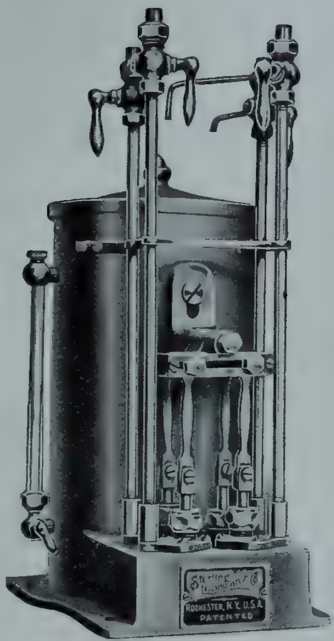
Sterling Force-Feed Lubricators



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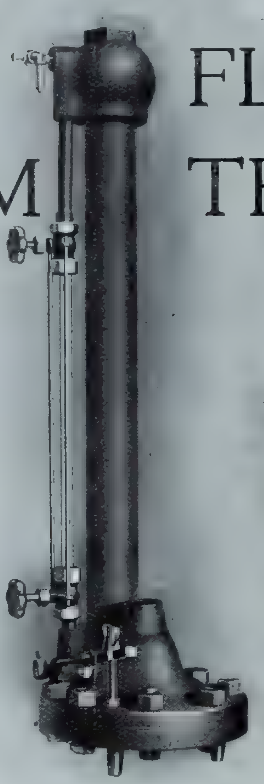

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This trap can be recommended for almost any and every class of work, for it is the **only steam trap on the market that embodies such simplicity with an equally wide range of possible adaptions.**

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No subsequent attention is required to be given to the

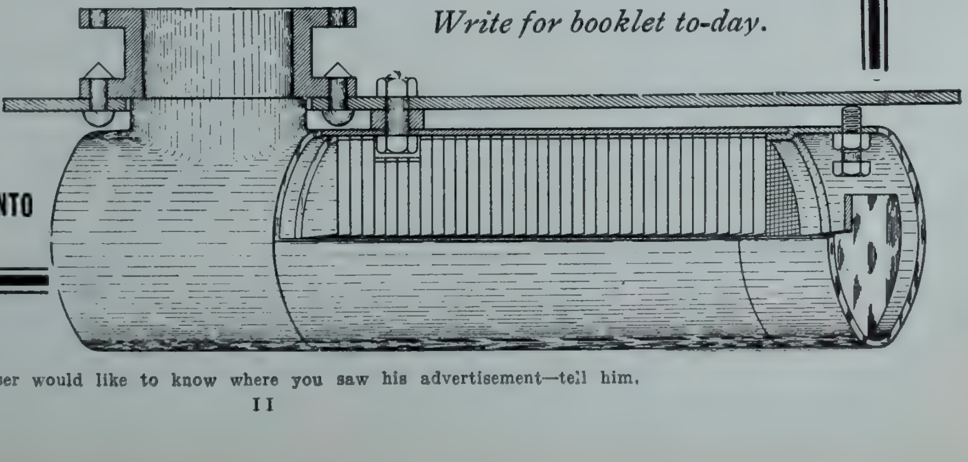
Ideal Internal Steam Separator

The "Ideal" makes for economy by saving oil, packing and time and by lessening wear and tear on engines, pumps and compressors. It will safeguard your engine against damage through water-shock and the going-out of cylinder heads. Dry steam is safe and the "Ideal" will positively give you Dry Steam.

Write for booklet to-day.

The Ideal Steam Separator & Supply Company,

820 Euclid Ave. - TORONTO



No Tinkering Here

"I don't know when this Morehead Steam Trap was put here, but I heard Dad tell another fellow that it was in the line when he took the job and that it never gave any trouble and saved a h—— of a lot of coal."

Morehead Steam Traps

Most steam traps BEGIN your troubles—the Morehead ENDS them. Its movement is so simple and natural that nothing can get out of repair—you won't have to sleep with a repair kit under your pillow. There is no wastage of steam at the outlet, for it is always covered with water. The steel construction puts it in the pressure-proof class.

Get "Trap Wise" by sending for a copy of "Trap Book" and trial proposition.

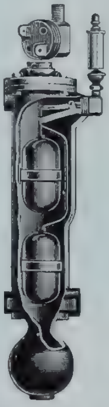
MOREHEAD MFG. CO.
Dept. "J"
DETROIT, - - - MICH.

Canadian Representatives:—A. R. Williams Machinery Co., Toronto; W. H. Markle, Montreal; Park Bros., Chatham, Ontario.

The Warning Whistle

The best boiler on earth is liable to explode if the water falls too low. And, if the water reaches too high a level, it not only endangers the engine but wastes fuel and reduces steaming capacity. None of these can happen to any boiler that is equipped with the

RELIANCE SAFETY WATER COLUMN



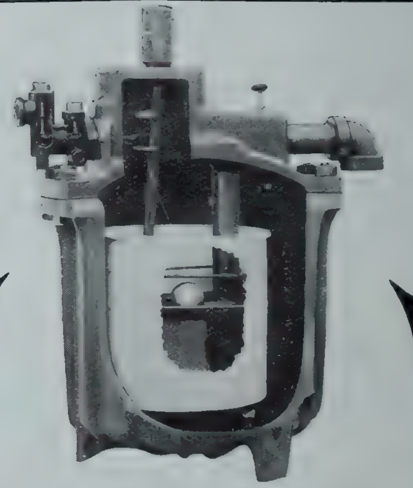
The Reliance Column is entirely mechanical in operation. Whenever water rises above or falls below the right level, it causes the whistle to blow and keep right on blowing until the matter is attended to.

For some classes of boilers we recommend the Reliance Column for low water alarm only.

Write for interesting Illustrated Reliance Catalog.

The Reliance Gauge Column Co.
5902 Carnegie Ave., Cleveland, Ohio.

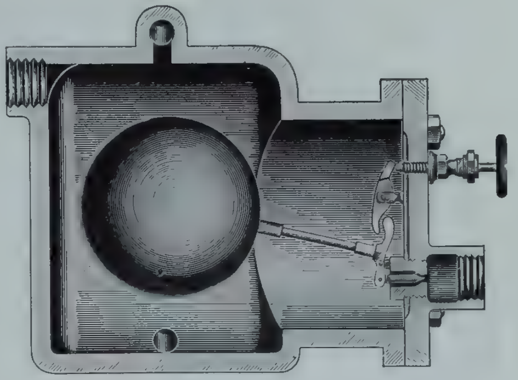
Alko Manufacturers of the Reliance Steam Traps, Reliance Lever Water Gauges, Reliance Lever Gauge Cocks.



The First Return Trap

was invented and marketed by us over 40 years ago. We have improved ever since, under the supervision of the inventor. The result is a splendid Trap—as near perfect as possible. Prices and catalogue cost you nothing. May we send them?

THE ALBANY STEAM TRAP CO.
319 N. Pearl Street
Albany, - N. Y.



You can Rely Absolutely on the Reliance Steam Trap

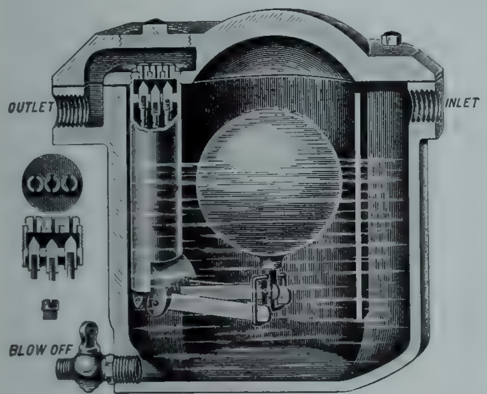
The Reliance is not an expensive trap, nor is it in the least complicated. It is designed on a principle as simple as it is correct. It handles every drop of condensation whether it comes in driblets or in floods. In Capacity, Durability and Efficiency the Reliance Steam Trap is positively unequalled. We guarantee it.

Write for complete catalog

The Reliance Gauge Column Co.

5902 Carnegie Avenue, :: CLEVELAND, OHIO

We also manufacture the famous Reliance Safety Water Column, Reliance Lever Water Gauge, Reliance Lever Gauge Cocks.



For Pressures up to 250 lbs.

WRIGHT "EMERGENCY"

High Pressure Continual Flow

STEAM TRAP

The "Emergency" trap drains the water from steam systems automatically and continually without steam waste and regardless of small flow or flood.

Write for pamphlet W.

DARLING BROTHERS, LIMITED

TORONTO 15 Ottawa St., MONTREAL WINNIPEG

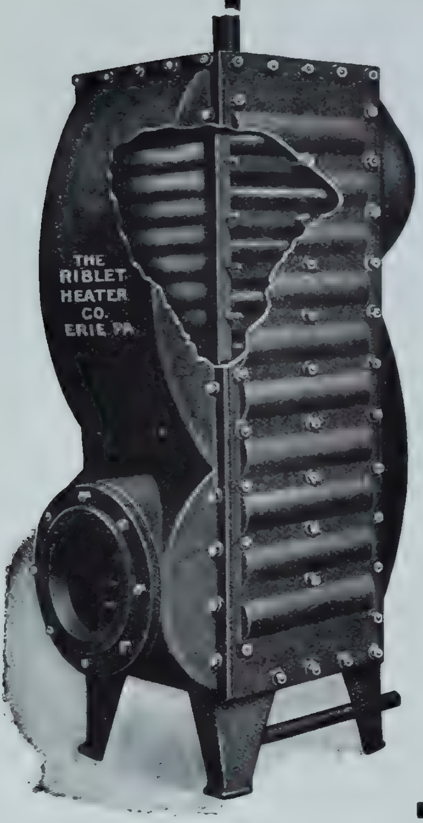
30 Days' Free Trial

¶ We are quite satisfied that the

Duffy Steam Trap

will work perfectly on all steam pressures from 5 to 200 lbs., but *you* may not know the "DUFFY." May we acquaint you with its virtues by sending you one on 30 days' FREE TRIAL? If you don't find it comes nearer the ideal sought after by engineers than any other trap on the market, send it back at our expense. It is simple of construction, occupies small space, and possesses large draining capacity. Avail yourself of our offer, or at any rate send for booklet.

Francis Duffy, 136 Stuart Street, Kingston, Ont.



Raise your steam at less cost

by feeding your boiler with HEATED WATER. This can be done most effectively by installing the

Transverse Current Water Heater

which will decrease your fuel bills by making use of a large part of the heat value of your fuel now being wasted.

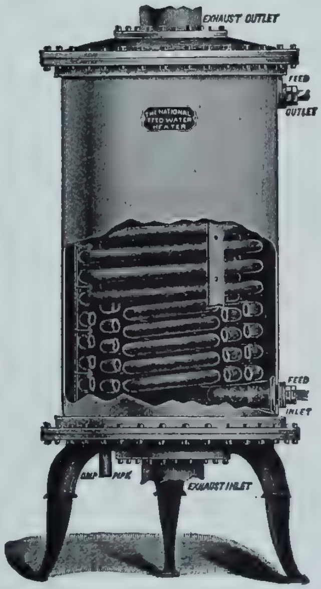
This heater has no tubes to scale, no joints to leak and no floats to require attention. All passages are easily accessible, and it is practically self-cleaning. No oil separator is needed and it can't get out of order.

Send for our descriptive booklet "P."
It cannot fail to interest you.

The Riblet Heater Company
Box 18, Erie, Pa.

General Agents in Canada

The Standard Engineering Co., Limited
47 Wellington St. East - - - - : - - TORONTO



Plain Common Sense

PRINCIPLES GUIDED THE ORIGINATORS OF THE

NATIONAL FEED-WATER HEATER

and there are no freak features about it. It is best because it is simplest. There are no inside joints to leak, no leaky straight tubes, no back pressure, and no contact of water with shell or iron. In the "National" Heater only drawn brass or copper tubing is used, metals which guarantee highest efficiency and greatest reliability.

WE HAVE A CATALOGUE. ASK US FOR A COPY

The
**NATIONAL
PIPE
BENDING
COMPANY**
91 LLOYD STREET
New Haven, Conn., U.S.A.

Hello!
Gone
Again!!

Most engineers know what it means to have the gasket blow out of a flange joint.

It ALWAYS means trouble for the engineer, and especially so when, as often happens, the two sections of pipe are the least bit out of alignment.

FREQUENTLY it means shutting down some section of the plant until the repair is made. Moral : –

Use the Dart Flange Unions

Joints made with the Dart Union will never leak. The Dart Union is a ball joint. Both sections have bronze seats, smoothly ground, and fit so snugly that a Dart Union Joint will stay tight until you deliberately loosen it.

Dart Union Joints will not rust nor corrode — they absolutely eliminate steam leakage. Require no packing and do away with all work fixing joints. Try them.

Dart Union Co., Limited

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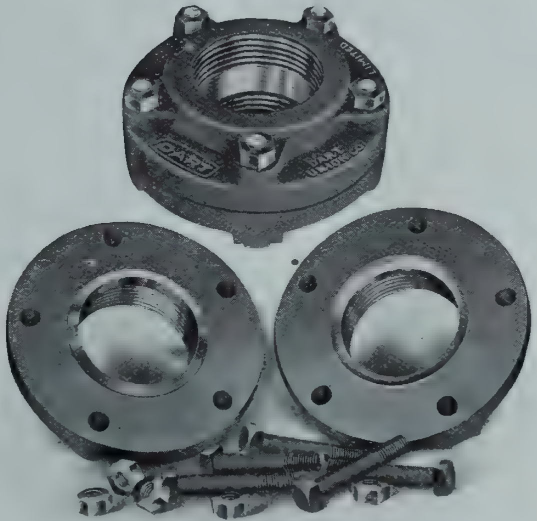

"Never Mind that Belting.
Get the other stuff in
first. Water won't hurt

"AMPHIBIA"
WATERPROOF BELTING

Takes to water like a frog and runs in any steam or other moisture laden atmosphere. It's a "Waterproof belt" that IS Waterproof.

Made by

Sadler & Haworth
ESTABLISHED 1876

MONTREAL, 511 William St. TORONTO, 27 Melinda St. ST. JOHN, N.B., 89 Prince William St.
WINNIPEG, 244 Princess St. VANCOUVER, B.C., 217 Columbia Ave.

TO INSURE SATISFACTION—STATE WHERE BELT IS TO RUN

Good Lace Leather for Belts

A small thing in itself, but on its quality depends the strength of the belt.

The Goodhue Lace Leather

is a buffed lacing of soft, tanned rawhide of the highest grade.

A trial order will convince you that what we claim for our lace leather is not exaggerated—and a trial order will not cost very much. Send it now.

J. L. GOODHUE & COMPANY, Limited
Manufacturers of Leather Belting and Lace Leather : : DANVILLE, P.Q.

PURCHASING AGENT.

Purchasing Agent: "What's this—a new main drive belt wanted? You *have* a nerve! Why, man, it was only a few months ago we bought a brand new belt from Soakem & Runn, Limited."

Engineer: "Sure, it was a brand new belt all right and looked very pretty. It's done for already. *This* time I want the old reliable **D. K. McLaren Genuine British Oak Tanned Leather Belting.** It's the best belting made and will last longer and give more satisfactory service than any other. *Quality* before price is the best rule in buying belting. Let's write for their price list *now.*"

D. K. McLAREN, Limited

MONTREAL
309-11 Craig Street West

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QUEBEC
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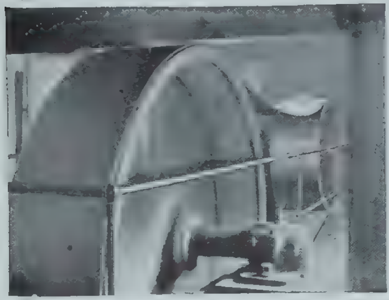
64 Prince William Street

VANCOUVER, B.C.
418 Abbot Street

Full Stock of Our "Extra C" Leather Belting and "D. K." Balata at above addresses.

Make this test for belt slip



Put speed indicators on both pulleys for one minute. Divide diameter of driver by that of driven and multiply by R.P.M. of driver. Unless the result is within 1½ to 2 per cent. of R.P.M. found for the driven pulley, the belt slip is excessive. You then waste power, and the life of the belt is being shortened unduly.

Cling-surface prevents this slip by rendering the interior of the belt mellow and the surface soft and kidlike as in the natural hide. Belts treated with Cling-Surface run slack but will break before slipping. ALL the power can be utilized for real work---no initial tension to wear bearings, strain shafting and consume fuel and lubricants uselessly.

A trial of Cling-Surface costs practically nothing.
Your money back if you don't like the results.
Write for literature.

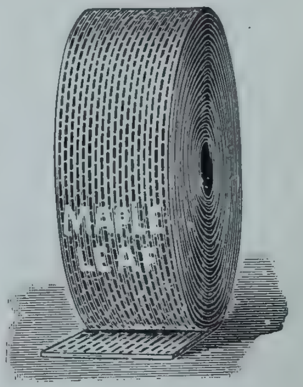
Cling-Surface Co., 1057 Niagara St. Buffalo, N.Y.
New York, Boston, Chicago, Toronto, etc.

DOMINION BELTING CO., Limited
HAMILTON, CANADA
SOLE MANUFACTURERS OF THE CELEBRATED

"MAPLE LEAF" BRAND
Stitched Cotton Duck Belting

FOR TRANSMISSION OF POWER, CARRYING, ETC.
THE TRUEST RUNNING

THE STRONGEST



THE MOST ECONOMICAL BELT

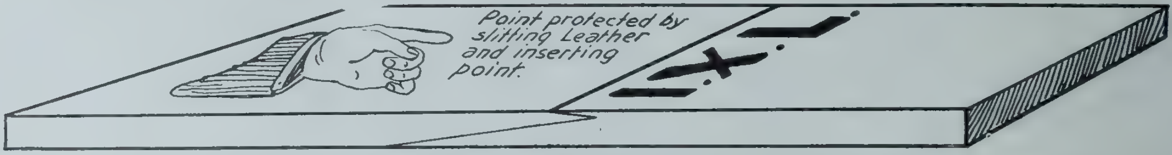
MADE IN CANADA

As a Main Drive Belt "Maple Leaf" cannot be excelled. Write for prices.

"MAPLE LEAF" BELT DRESSING is the best on the market for all kinds of belts.

THE "I.X.L." SPLICE

"THE BELTING SPLICE THAT WILL NEVER COME OPEN"



The great trouble with *any* belting—no matter how good the leather—that is joined up with the ordinary splice, is the fact that the splices come open, causing loss and delay. J. D. McArthur's Leather Belting made with the "I.X.L." SPLICE, as shown in this cut, *cannot* come open at the splices. Note the protected point, outside point running same direction as pulley.

J. D. McArthur's Leather Belting is made from Prime British Oak-Tanned Leather, from Close-Trimmed Backs exclusively.

Write for our complete price list.

J. D. McARTHUR & CO., Brockville, Ontario

Stock at Toronto Branch 639 King St. East; J. E. Stephenson & Co., Agents

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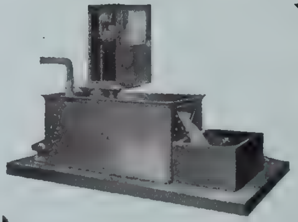
If you have Joint Troubles,
If you have New Pipe Lines to erect,
If you have Superheat, Moisture, Oil, Gas, Water or Acid to care for,
In a word, if you have Pipes (screwed or flanged),
Cylinders, Receivers, Economisers, Heaters, Radiators, etc., in use, you require

HAWKINS IMPERISHABLE JOINTING CEMENT
"IMPERISHABLE"

HAWKINS' IMPERISHABLE JOINTING CEMENT

Send for Booklet and Prices.

BAIN & MITCHELL, Y.M.C.A. Building, **MONTREAL**
Sole Canadian Agents for
W. T. HAWKINS & CO., HUDDERSFIELD, ENG.



"Self Contained Apparatus"

THE "LEA" RECORDER

for measuring

BOILER FEED-WATER
AIR PUMP DISCHARGES

and other flows, by means of the V notch.

Sole Canadian Agents
Drummond, McCall & Co.
MONTREAL

Ice Making and Refrigerating Machinery

SUPPLIED AND INSTALLED ON

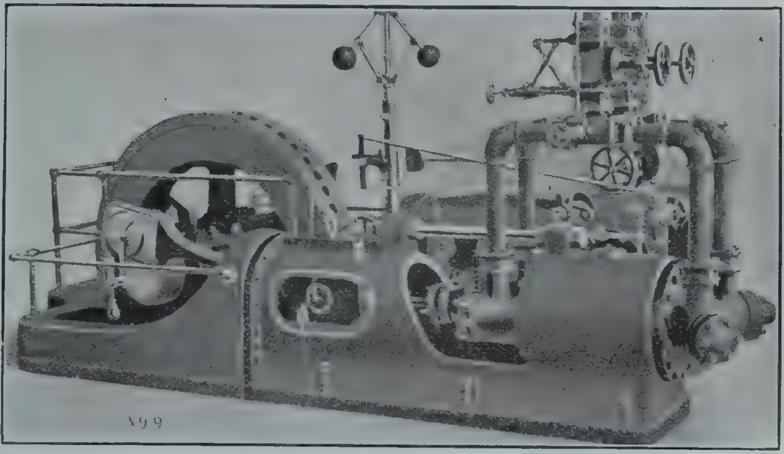
The York Manufacturing Co. Systems

For Ice-making Plants, Cold Stores, Abattoirs, Packing Houses, Dairies, Breweries, Hotels, Apartment Houses, etc.

Horizontal and Vertical Compression Plants

Absorption Plants

Ammonia Fittings and Supplies



Horizontal Double-Acting Compressor—Steam Driven

Nonpareil Corkboard Insulation

For Cold Storage Buildings, Packing Houses, Abattoirs, Refrigerators, Etc.

INSTALLED IN HUNDREDS OF THE MOST MODERN COLD STORAGE PLANTS, PACKING HOUSES AND BREWERIES IN THE UNITED STATES, CANADA AND MEXICO

FURTHER PARTICULARS AND CATALOGUES ON REQUEST

The Kent Company, Limited

Refrigerating Engineers and Contractors

Montreal, P.Q.

Peerless Automatic Head Protector

Most Efficient and Reliable Apparatus of its kind on the Market.

Ammonia Proof—Fume Proof. Light in Weight and Compact

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THE VINTON COMPANY
256 Broadway, NEW YORK

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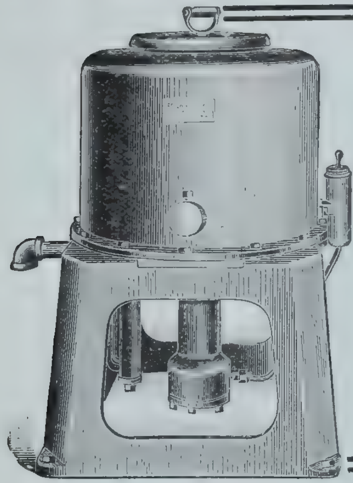
Represented in Ontario and Quebec



Save the Oil—Don't Waste Waste

We Manufacture—OIL and WASTE MACHINES, CHIP MACHINES, TURBINE CENTRIFUGAL OIL FILTERS, and CENTRIFUGAL EMULSION MACHINES

We have machines with—The E. B. Eddy Co., Ltd.; Grand Trunk Ry.; Can. Pac. Ry.; Dominion Coal Co.; J. R. Booth; Toronto Water Works; T. Eaton Co.; Montreal Street Ry.; Nova Scotia Steel & Coal Co.; Toronto Railway; Algoma Steel Co.; Quaker Oats Co.; B. Greening Wire Co.; Imperial Oil Co.; Canadian Copper Co.; Sarnia Electric Light Co.: Robert Mitchell Co.; Montreal Rolling Mills; Canada Screw Co.; Crow's Nest Pass Coal Co.; Dominion Iron & Steel Co.; Temiskaming & Northern Ontario Railway Co.; Consolidated Mining & Smelting Co.; Montreal Cotton Co.; Frost & Wood Co., Ltd.; Dominion Textile Co., Ltd., and many others.

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The Canadian Oil and Waste Saving Machine Co. Limited
BROCKVILLE, ONTARIO

INSULATING PAPERS

Standard for 25 Years

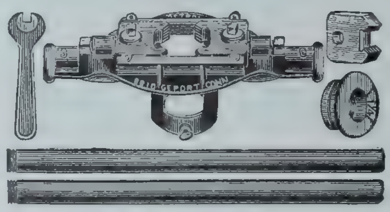
GIANT

P&B TRADE MARK REGISTERED

Impervious to moisture, unaffected by acids, alkalis, gases, fumes, heat or cold.

Manufactured in Canada exclusively by

The
Standard Paint Co.
of Canada, Limited
MONTREAL



GENUINE ARMSTRONG STOCKS AND DIES FOR CUTTING PIPE & BOLTS ARE THE BEST.

- *PIPE MACHINES*
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- *HINGED PIPE VISES*
- *RATCHET ATTACHMENTS*

Manufactured by
THE ARMSTRONG MFG. CO.
298 Knowlton St.
BRIDGEPORT, CONN.
NEW YORK *CHICAGO*
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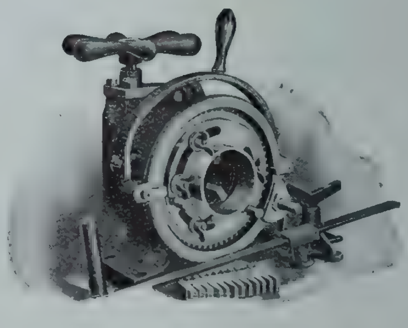
U.S. AND BARKEEPERS FRIEND METAL POLISH
USED AND ENDORSED BY THE LEADING DEALERS
SOLD ALL OVER THE WORLD



ECONOMIZE

Man Power

One man with our pipe-threading and cutting machine can do more work, do it better, and at less expense than 3 or 4 men working in the old-fashioned way.

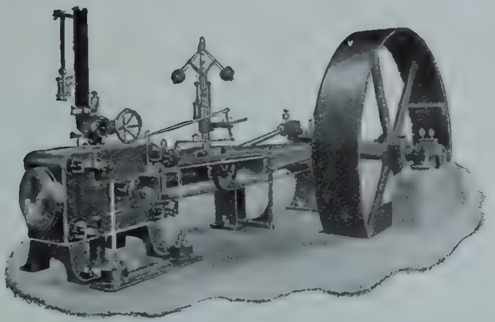
It's the man-power that expands the cost.

CIRCULAR?

THE CURTIS & CURTIS CO.
26 Garden Street,
BRIDGEPORT, - - CONN.

"Vilter" Corliss Engines

Girder or Heavy Duty Type Bed. High-pressure, Compound and Compound Condensing.



Our new valve-gearing permits of high speed and close regulation. Especially adapted to Direct-connected units.

Some of our Customers in the Dominion of Canada

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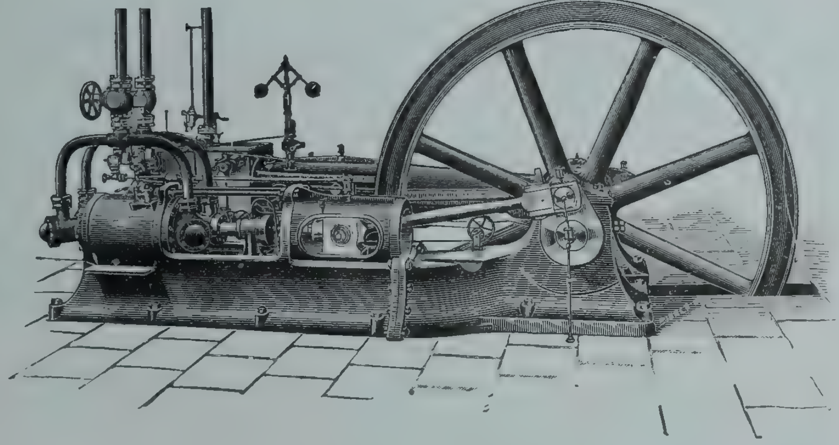
"Vilter" Ice Machines

Small size Vertical or Horizontal Ammonia Fittings and Supplies



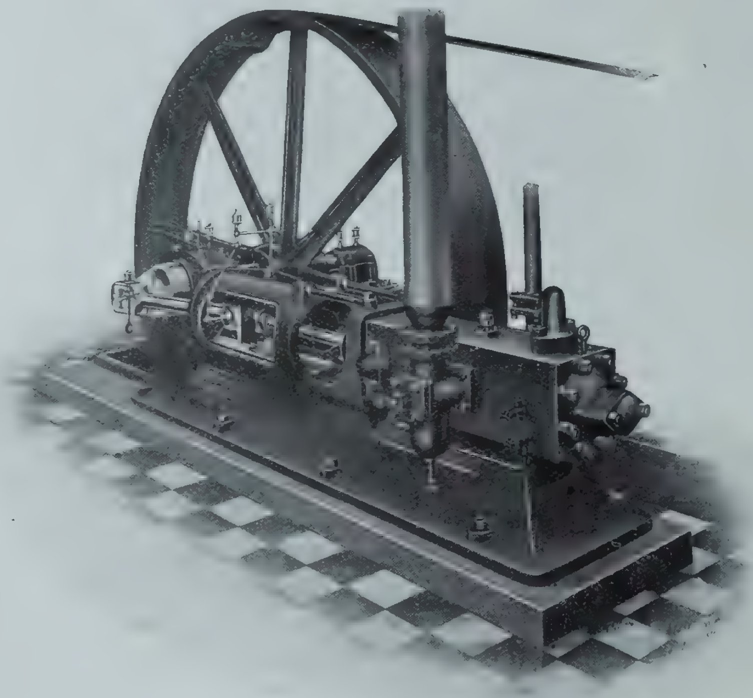
Large size Horizontal Ammonia Condensers, Double-Pipe Brine Coolers

The Vilter Manufacturing Co. ESTABLISHED 1867

242 Becher St. Milwaukee, Wisconsin, U.S.A.

Catalogues and estimates mailed on application

Kroeschell Carbonic Anhydride System of Refrigeration



SINGLE UNITS IN ALL CAPACITIES FROM 3 TO 125 TONS.

Highest Efficiency——No Odors
No Danger of Explosion

The hundreds of our plants in daily operation throughout the country prove conclusively the superiority of our system.

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Kroeschell Brothers Ice Machine Co.
456 W. Erie Street, - - CHICAGO, ILL.

New York—136 Liberty St., John T. Lapham, Mgr.
Canadian Representatives—Messrs. Scott, Campbell & Co., 65 Victoria St., Toronto

You Do Not Realize

WHAT YOU ARE MISSING IF YOU HAVE NEVER USED

"TAURIL"

High-Pressure Jointing

ON HIGH-PRESSURE WORK

¶ "Tauril" is designed to meet every condition resulting from the rapidly increasing use of high pressures. It will stand a varying temperature up to 572° Fahrenheit; has a tensile strength of three tons per square inch and stands a compressive strain of fourteen tons and still retains its elasticity.

¶ Try it on the following:—Steam (dry or superheated), Water, Motor Cars,

Refrigeration Plants

(Ammonia and Cold-air Systems), Compressors and long lengths of pipe to auxiliary machinery (subject to condensation, water hammering and unequal expansion.)

¶ There is only one "Tauril"—beware of imitations. While imitation may be sincere flattery of a *manufacturer*, it generally is hard lines on the *buyer*.

Write for booklet on "Tauril," giving list of satisfied users.

The
Garlock Packing Co.
Sole Distributors for Canada
Hamilton, Ontario

To People Who Use Live Steam in Manufacturing Processes

HAVE you been putting up with scaly boilers, wasting fuel, shutting down once in a while to pound scale out of boiler tubes? Have you been doing this because you fear boiler compounds might contaminate your steam? Let us tell you this:

☞ There is a man in Toronto engaged in a business where live steam direct from the boiler is brought into contact with fine white silk fabric. He says the slightest presence of injurious chemicals in that steam would ruin the silk. He uses Red Star Compound, and he says that:

RED STAR

BOILER COMPOUND

POSITIVELY DOES NOT CONTAMINATE STEAM IN ANY WAY

We can demonstrate to your absolute satisfaction these two things: 1. That Red Star Boiler Compound will free any boiler from old scale and prevent absolutely the formation of any new scale. 2. That Red Star Boiler Compound will not contaminate steam; and that it can be used with perfect safety in plants where live steam is used in cooking foodstuffs.

60 DAYS' FREE TRIAL

Send us a gallon sample of your feed water, we will analyze it, make up and send you a quantity of Red Star Compound, and an automatic feeder. Use it for ninety days, if it is not just as we claim, ship it back at our expense. If it is satisfactory send us a check for the amount of invoice. Could *any* offer be fairer than this?

Write for Booklet Giving Full Particulars—Write Now

Hygienic Laboratories
Limited
11 COLBORNE STREET :: TORONTO

Winnipeg Representative: Francis Sedziak, 780 William Avenue. *Montreal Representative:* W. S. Chandler, 5 Thistle Terrace

The Value of Practical Experience in Cold Storage and Refrigeration

THIS page is directed to people who are contemplating the erection of Cold Storage and Refrigerating Plants, or the extension of existing plants.

¶ In this particular branch of work, viz.: Refrigeration and Cold Storage, I claim to be an expert.

¶ Many years of practical experience with a large number of successful installations, in many countries, substantiate this claim.

¶ I am not a selling agent for any manufacturer. Neither am I prejudiced for or against any particular system or method of refrigeration. In carrying on the business of Cold Storage Architect and Refrigeration Expert, I am giving my clients the benefit of an extensive experience, and unbiassed expert service.

¶ In soliciting business from you I invite correspondence on any matter connected with refrigeration from the purchase of machinery and supplies to the designing and supervision of a complete modern refrigerating plant.

E. J. Greenstreet, F.R.A.I.C.

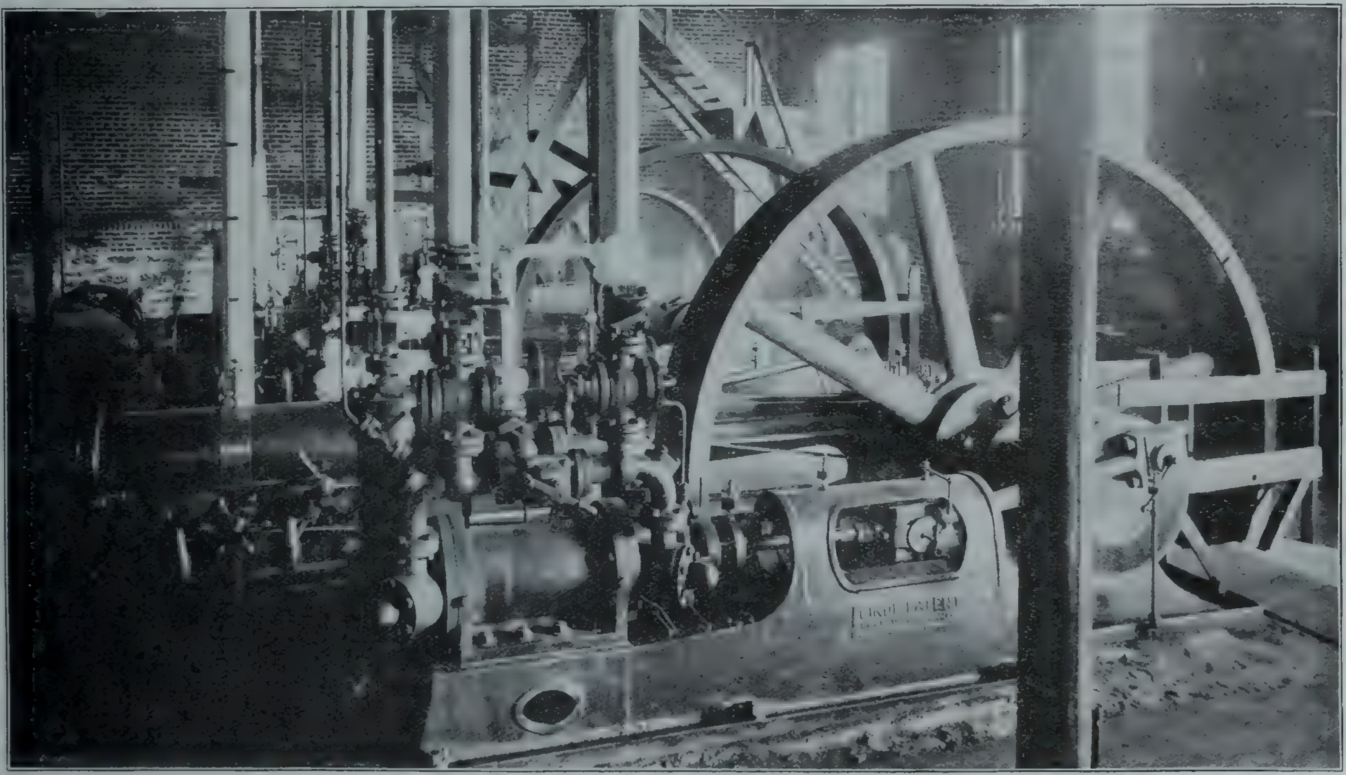
COLD STORAGE ARCHITECT AND REFRIGERATING EXPERT

32 ADELAIDE STREET EAST : TORONTO, ONTARIO

The Linde Systems

OF

REFRIGERATION



The Advantages of The Linde Patented Pure Air Circulating System :

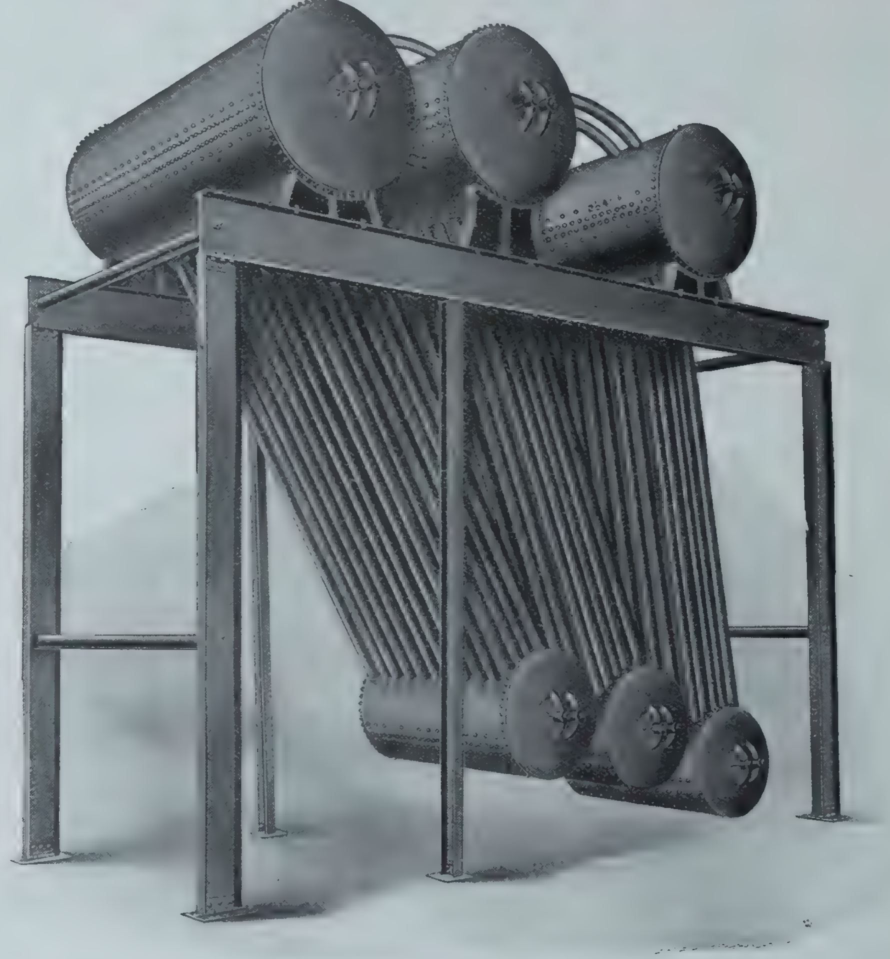
Simplicity in Construction
Entire Absence of Snow or Drip in Rooms
Quicker Chilling or Freezing
Perfect Ventilation and Pure Air
Goods in Finer Condition, less shrinkage loss
Greater Cooling Efficiency
Greater Economy in Space

The pure Air Circulating System is only one of our systems. We install any other, such as Expansion Systems, Brine Systems, etc.

The Linde British Refrigeration Co., Limited
MONTREAL

Water Tube Boilers

Return Tubular, Horizontal Marine, Vertical and Portable Boilers, with or without Wheels



Side View of our NEW WATER TUBE BOILER. Not bricked in.

Our Engines, Boilers, Heaters, Pumps and Condensers are Prominent in Canada's Largest Power Houses.

The Goldie & McCulloch Co., Ltd.

Galt, Ontario, Canada

WESTERN BRANCH
248 McDermott Ave., Winnipeg, Man.

QUEBEC AGENTS
Ross & Greig, Montreal, Que.

BRITISH COLUMBIA AGENTS
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WE MAKE Wheelock Engines, Corliss Engines, Ideal Engines, Piston Valve Saw Mill Engines, Gas Engines and Producers, Boilers, Heaters, Steam and Power Pumps, Condensers, Flour Mill Machinery, Oatmeal Mill Machinery, Wood-Working Machinery, Transmission and Elevating Machinery, afes, Vaults and Vault Doors.

Ask for Catalogues, Prices and All Information.

Refrigeration and Cold Storage as Applied to Commercial Undertakings

By E. J. GREENSTREET, F. R. A. I. C*

In discussing the subject of refrigeration and cold storage as applied to commercial undertakings, particularly in connection with packing plants, abattoirs, breweries, and cold storage warehouses for handling perishable produce of various kinds, the question is frequently asked: "Which is the best system of refrigeration to adopt?" It is absolutely impossible to answer such a question by a direct reply which will meet each and every case, and the only answer is, that it depends entirely upon a number of circumstances, and many varying conditions, all of which must be taken into consideration before it is possible to arrive at a correct and satisfactory conclusion.

To obtain the best results in the application of refrigeration to commercial purposes a number of factors have to be very carefully weighed. The writer proposes to deal with some of these conditions and will endeavor to show that there are many points requiring careful consideration before deciding upon the method of applying refrigeration to cold stores, packing plants, dairy factories, etc., etc., and before it is possible to answer intelligently the question, "Which is the best system of refrigeration to adopt?"

Refrigerating Machinery.

It is not intended to deal in this article with the various types of refrigeration machinery on the market, but more particularly with the manner in which the refrigerating agent is applied. In other words it is proposed to consider, not so much the refrigerating effect obtained by the compression, cooling and expansion of N.H.3 or CO2, but rather the manner in which this refrigerating result is applied to extract the heat from newly killed meat in an abattoir, from wort in a brewery, or from various kinds of produce in a cold store, as well as the different methods of application in vogue for maintaining the various rooms in refrigerated buildings at the requisite temperatures.

The necessary refrigeration may be produced in various ways and there are several excellent machines on the market, manufactured by firms with a long and extensive experience in this special business. Whether they are operated on the ammonia compression or ammonia absorption principles, whether some other refrigerating agent such as CO2 is used, or whether the compressors are horizontal or vertical, single or double acting, operated on the "Wet" or "Dry" system or in whatever manner the refrigeration is produced, the application is equally important. It matters not how good the machinery may be, or how economically a given amount of refrigeration can be produced, the best results can never be obtained unless at the same time, the refrigeration is applied to its work in such a manner as to deal effectively with the varying and often totally different conditions found in actual practice.

Operation of a Plant.

To lead up to this subject of the application of refrigeration, it may be well to outline briefly the operation of a typical refrigerating plant, say for instance a machine working on the ammonia compression principle.

In such a case anhydrous ammonia, which at ordinary atmospheric pressure boils at minus 30 deg. F., (that is changes from a liquid to a gas) is drawn into a compressor, and forced under pressure into coils of pipes. The heat generated during compression is removed by passing water over these coils. The combined action of pressure and temperature liquifies the gas. The lower the temperature to which the gas can be cooled by the water, the less pressure necessary; and the higher the temperature of the cooling water the greater the pressure required. The liquid ammonia when released from pressure changes again to the gaseous form, and as heat is absorbed in doing so refrigeration is produced. After having done its work in this manner, by taking heat from the nearest and most convenient source, the gas is returned to the compressor to be again compressed, cooled, liquified and expanded.

Up to this point a given quantity of refrigeration has been produced, let us assume for example that during 24 hours 50 tons of refrigeration has been produced; or expressed differently, sufficient heat has been taken from somewhere to melt 100,000 lbs. of ice.

Although this work has been done we have not necessarily got the refrigeration just where it is wanted; let us therefore see how it can best be applied to the various commercial purposes for which refrigeration is needed.

Methods of Application.

There are three distinct methods of applying refrigeration to cold storage buildings. The pipes containing the expanding ammonia may be placed directly in the rooms to be cooled, thus taking up heat from the rooms and from the goods stored in same. This is known as the "Direct Expansion System." When adopted there are a number of important points requiring consideration, such as the area of the pipe surface in proportion to cubic contents of rooms, and in proportion to the amount of heat to be extracted from meat or other goods contained in such rooms, and also the different ways of arranging the pipes.

Instead of placing the expansion pipes directly in the rooms they can be kept outside, and allowed to take heat from some other medium, which in its turn is circulated through the various chambers of a cold store, and the refrigerating effect thus applied indirectly. As brine, of sufficient density to be noncongealable at the temperatures dealt with, is the medium usually employed, this method is known as "Brine Circulation."

A third method is to keep both the expansion pipes, and the brine cooled by the expansion pipes, outside the rooms and pass the air from the chambers over the cold surfaces of same. The air so cooled is conveyed to, and circulated through, the rooms by natural or forced circulation; generally forced circulation by means of fans or blowers, and ducts. This method is known as "Air Circulation."

Each one of these methods of application has certain advantages, and under some conditions has certain disadvantages. In applying refrigeration therefore to commercial purposes there are several points requiring careful consideration before deciding which method, or combination of methods, should be adopted in order to give the best and most satisfactory results. Let us therefore examine the advantages and disadvantages of each.

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Direct Expansion.

The direct expansion system, that is placing the pipes containing the expanding ammonia in the rooms has the advantage of being the most direct in its application of refrigeration, and it is also the most economical as regards the first cost of the installation. It is also easily regulated and very simple to operate. One objection sometimes advanced to this method is the danger of ammonia gas escaping with injurious results to the goods stored in the cold rooms. It is true there have been such cases on record, but with a properly installed plant, and good material and workmanship, this objection does not amount to much, and can I think be dismissed as hardly worthy of serious consideration. In support of this opinion it is only necessary to refer to the large number of cold stores equipped in this manner. It is a very common practice in many parts of the United States; and numerous freezing works and cold stores in Argentine, Australia and New Zealand are operated successfully on the direct expansion system.

In cases where hard frozen produce has to be dealt with, and where stores require to be kept at a low temperature, say 10 deg. F. to 15 deg. F., particularly in cases where there is but little moisture, and but few injurious gases given off by the goods, the direct expansion system may be employed with good results. What then are the disadvantages? The disadvantages are found when it is a question of dealing with considerable quantities of moisture and in cases where comparatively high temperatures are required. Also in instances where air circulation and ventilation are essential for the successful storage of certain kinds of produce. Moisture of course condenses on the coldest surfaces, and expansion piping, or brine piping, placed directly in the cold rooms, collects moisture in the form of snow, rapidly or otherwise according to the varying degrees of humidity. Such snow has to be removed otherwise the pipes become more or less insulated and the working of the plant, owing to faulty application, soon becomes less efficient. In cases where temperatures are comparatively high, the question of thawing and dampness in the rooms, has to be considered, and provision must be made for preventing dripping, dampness, and such excess of moisture as would be injurious to certain of the more delicate kinds of produce.

In the case of hard frozen goods, held in storage at comparatively low temperatures, this objection is not felt so acutely, as there is comparatively little moisture to deal with, but even in such circumstances the snow has to be removed from the pipes periodically.

Where large quantities of newly killed meat, however, are being refrigerated the amount of moisture is very considerable and such cases call for some other method than the comparatively crude plan of placing expansion pipes directly in the chambers, without making some provision for dealing with the moisture, and some proper arrangement for the necessary air circulation and ventilation required to handle the moisture and carry off the cases, vapor, steam, etc., always found in connection with newly killed meat.

Brine Circulation.

Some of the remarks in connection with the application of refrigeration by means of direct expansion piping, apply also to brine pipe refrigeration, for in this method of cooling, the pipes containing the cold brine are sometimes placed in the chambers, on walls or ceilings, or in pipe lofts, in much the same way as direct expansion piping. What is known as exposed brine circulation is sometimes adopted in connection with packing houses. One application of refrigeration by this method consists in constructing a separate chamber above the meat cooler, in which are placed open pans or distributing troughs containing the cold brine. This brine is circulated by means of a pump and is made to flow down, or trickle over, a series of cloths or curtains suspended vertically from the ceilings of the cooling lofts.

The difference in temperature between the air in the cooling lofts in contact with the cold brine, and the lower part of the room, containing the carcasses is relied upon to give a natural circulation of air. This circulation and interchange of air is generally sufficiently rapid and satisfactory as long as the difference in temperature between the two chambers is considerable, but as the hanging space containing the carcasses approximates to the temperature of the brine chamber, the air circulation of course decreases, and finally ceases as soon as the two temperatures are the same.

Refrigeration by brine circulation is slightly more expensive as regards the first cost of the plant than direct expansion. There is also some loss in efficiency owing to the method beling less direct, and owing to the fact that it is necessary to employ another medium, the heat consequently being less directly transferred to the expanding ammonia. On the other hand there are certain distinct advantages in this method. The very fact of first communicating the refrigerating effect to the brine, may be turned to good account, and may in some cases be utilized with excellent results. By this method it is possible to store up a large body of cold brine, and thus provide a reserve of refrigerating power, impossible to obtain in any other way, and such reserve fund may be drawn upon when the refrigerating machinery is not in operation or is temporarily shut down for any reason.

In the ordinary direct expansion plant, as soon as the machinery is stopped, refrigeration ceases. No more gas is circulated, compressed, liquified, and expanded and consequently no further cooling can be done. The cold rooms can only be maintained at or near their required temperature by means of the insulation, and that only for the time being.

Assuming the outside temperature to be very much higher, the temperature of the rooms will certainly and surely rise. The length of time it will take for the inside and outside temperatures to approximate will depend on the rate of transmission of heat through the walls, in other words on the quality and thickness of the insulation. In the case of brine circulation it is possible to store up a reserve of refrigeration. If the machinery is sufficiently powerful, and provided arrangements are made for storing up a given quantity of brine, a fixed and definite quantity of refrigeration (the exact amount of which can be readily calculated) can be stored up and held in reserve. When the machinery is shut down this reserve can be utilised by simply continuing the circulation of the cold brine.

It is also possible to maintain in rooms cooled by brine circulation a very steady and even temperature. A very large percentage of the chilled beef sent to the British market, and to which reference was made in the January number of The Power House, is carried by means of brine refrigeration, and the temperature maintained in the holds of the vessels, even during the long voyage from the Argentine, and Australia, does not vary for the whole time, more than the fraction of a degree.

Air Circulation.

Two very important and widely used methods of applying refrigeration to cold storage buildings and commercial purposes generally, have been referred to above. Equally important is the method known as "Air Circulation." The fundamental difference between this system, and those already dealt with, is that the rooms to be cooled contain no piping whatever. The air is reduced in temperature in a separate chamber or space called the "Air Cooler," generally situated entirely outside the cold rooms. The air is then conveyed to, and passed through the various chambers, by means of forced circulation. This cooling of the air in a separate air cooler, may be accomplished in a variety of ways. Sometimes it is passed over cold brine falling over a series of plates, or over refrigerated brine falling directly over expansion coils. In both such cases the object is to split up the body of cold brine so as to bring it more thoroughly in contact with the air, and the heat transference is carried out on the converse principle of a water cooling tower. In the case of a cooling tower the heat of the water is transferred to and removed by the air. In a cooler in a cold store, the heat of the air is transferred to, and removed by the cold brine.

Fans or blowers are used in conjunction with air ducts to maintain a circulation of air in the rooms, and from and to, the air cooler, and thus a forced circulation of air is maintained. This is one of the principal differences between cooling by means of air circulation and refrigeration by means of brine pipes or direct expansion pipes. As we have seen air circulation, in cases where refrigerating pipes are used directly in the rooms, depends upon the difference in temperature between the air immediately surrounding the pipes, and the temperature of the goods to be cooled. As these relative temperatures are continually changing, air circulation must also be uncertain and continually varying. With forced circulation on the contrary the circulation of air is under control and can be maintained constant and steady. In the "Air Circulation" system, where the air is passed over cold brine, the moisture is also dealt with in an entirely different manner. Instead of collecting on the room piping in the form of snow, which has to be periodically removed, the moisture is taken up by the brine in the air cooler and the air consequently washed and purified. The rooms therefore are kept perfectly dry and free from excessive moisture, and ventilated more thoroughly than by the other method, where natural circulation alone is relied upon. In cases where large quantities of hot vapors have to be dealt with, where comparatively high temperatures are required, and in circumstances where much moisture and various impurities are given off from the goods to be refrigerated, or held in cold storage, the above are some of the advantages that must be credited to "Air Circulation."

The question of dealing with moisture in cold storage operations is of the utmost importance, and is frequently neglected, with the result that considerable trouble is often experienced. It has been shown what happens when brine or direct expansion pipes are placed directly in the rooms, in such cases there is nothing for it but to remove the excess of moisture in the form of snow. With air circulation, although the moisture is handled outside the chambers, we have not quite finished with it. The cold brine continually taking up moisture naturally becomes a weaker solution, and the requisite density can only be maintained by removing the excess of water on evaporation, or by adding more salt.

Where mechanical refrigeration is used, as it is in the majority of cases where refrigeration is needed in commercial undertakings, the three most important methods of application have been referred to. There is another system however which has been employed in parts of the United States and in Canada, in localities where natural ice can be harvested and stored at a low cost and that is a method known as the

Gravity Brine System.

In the early days, many cold stores were built in Canada, and in the United States, designed to be operated entirely with natural ice, which was harvested from the nearest lake, river, or canal. The usual method was to construct a storage room for the ice immediately above the rooms to be cooled, and into which the season's supply of ice was placed. Arrangements were made for obtaining a natural circulation of air, that is, openings were provided through which the colder air could find its way into the rooms by gravity, and other openings constructed through which the warmer air could be returned to the overhead ice chamber, much on the principle of an ordinary household refrigerator. Many and various were the arrangements adopted to utilize the refrigerating effect of melting ice. In some cases cylinders or tanks containing a freezing mixture of ice and salt were used in conjunction with this method of cooling by means of overhead ice. In the nature of things it is absolutely impossible to obtain satisfactory results from the melting of ice alone. As ice melts at 32 degrees F. it is impossible to obtain in actual practice, temperatures much below 38 degrees F., in these so called cold rooms. Even with such temperatures the air circulation must of necessity be sluggish and the dampness in the rooms considerable.

As nearly all kinds of produce placed in cold storage require lower temperatures than 35 degrees F., it is impossible to expect satisfactory results from cold stores operated with ice alone. The gravity brine system is however a very different proposition from refrigeration by means of overhead ice. This system is based on a freezing mixture of ice and salt, employed to cool brine contained within pipes, and circulated through the rooms by means of gravity, assisted by the difference in temperature of the brine in the upper and lower portions of the containing coils. These brine coils are placed directly in the rooms to be cooled, or may be kept outside the rooms in an "Air Cooler," and a forced circulation of air employed, in much the same manner as refrigeration is applied in the system previously referred to in connection with mechanical refrigeration. In actual practice it is possible to obtain temperatures as low as 12 degrees F. with the gravity brine system the results of course being similar to those obtained with mechanical refrigeration.

There are a number of cold stores in the United States, and several in Canada, operated on this system, and in localities where natural ice can be harvested cheaply, and stored conveniently, this method undoubtedly has a distinct value, and must be considered when dealing with refrigeration as applied to cold storage work. When to adopt it must depend entire,y upon circumstances. The magnitude of the operations ; the cost of ice ; the facilities for handling ; and the space required to store the season's supply of natural ice ; must of course receive careful consideration before deciding when and where this particular method of refrigeration should be employed.

Summary.

In dealing with the various methods of applying refrigeration, briefly outlined above, an attempt has been made to convey some idea of the importance of this particular branch of cold storage work.

Even with the best and most perfect type of refrigerating machinery, the whole problem of cold storage has not been solved, unless the manner in which the refrigeration is applied, has received just as much care and attention as the design and construction of the various portions of the plant.

However excellent the plant, however carefully erected and operated it may be it is absolutely necessary if the best and most satisfactory results are to be obtained, that very careful thought and consideration be given to the method of application. The writer has endeavored to show that there is no one method that will suit all cases, or give the best and most satisfactory results under all conditions.

Many questions have to be considered, and numerous varying factors have to be taken into account. Special arrangements should be made for dealing with the following conditions and problems frequently found in actual practice. Freezing and storing meats and other produce at low temperatures. Handling and cooling newly killed meats and dealing with produce giving off vapors, noxious gases, and considerable quantities of moisture. Arrangements necessary for storing at comparatively high temperatures, and for dealing with delicate produce such as eggs, fruit, etc., air circulation and ventilation.

The catalogues and literature issued by the various manufacturers of refrigerating machinery and appliances, deal exhaustively with the various portions of a refrigeration plant. Engines, compressors, condensers, fittings, ice making appliances, etc., are described at great length, and with considerable detail. The various purposes for which refrigerating is required are set forth very fully, and the absolute necessity of refrigeration in the case of packing plants, breweries, and for handling and storing meats, eggs, dairy produce, fish, fruit, vegetables is clearly shown, and fully dealt with. With one or two exceptions however such literature has but little to say on that most important point, viz., the method of application. Some manufacturers dismiss the question in a few words, or with some such remark as "We generally recommend the direct expansion system as being more economical to install and simple to operate" or "We are advocates of both the direct expansion and brine systems each in its proper place" or perhaps "We install either brine circulation, or direct expansion as preferred by the customer." As a matter of fact it is hardly within the province of a catalogue on refrigerating machinery to handle this end of the subject in detail, and in all its various phases. As such literature however, is often the only guide for those about to embark in cold storage operations, it is scarcely to be wondered at that the question is frequently heard "Which is the best system of refrigeration to adopt?"

The writer has endeavored to answer that question as far as it is possible to do so, and has tried to show that there is no one system which is "best" under all conditions. An attempt has been made to indicate some of the conditions frequently met with in practice, and to point out that the only satisfactory and logical way of dealing with them, is to study carefully the nature of the work to be accomplished, and then to apply the refrigeration in the best known manner to meet the requirements of each individual case.

EARLY REFRIGERATION.

The early history of mechanical refrigeration in Europe is somewhat obscure. Records of the cooling business are not obtainable until the 19th century, and even then it was not till about 1850 that proper records became available. About that time the natural ice business had grown to great dimensions, and it would appear as if natural ice had become the principal source of cooling effects in all countries. In 1834 an English patent on the subject of the utilization of compressed gas as a refrigerating agent was taken out by Joseph Perkins. In France, also in the 50's, Carre had worked at refrigeration first with ether and then with ammonia. From 1860 until 1870 was a busy time in the development of refrigerating machinery, and it then became apparent that the natural ice business would soon become a thing of the past. In 1870 Bell and Coleman installed refrigerating machinery on board the Strathleven, and brought the first cargo of frozen meat to London, and since then the fleet of steamers which was engaged in this business has become an enormous one.

NEW VILTER PUBLICATIONS.

Refrigeration machinery and Corliss engines are dealt with in the recent catalogue issued by the Vilter Mfg. Co., Milwaukee, Wis. A special feature of the Corliss engine catalogue is the new valve gearing, shown separately on page 14, and in connection with illustration of Corliss engines on pages 31 and 33. This new valve permits of close regulation and high speed. The governor for close regulation and direct connected units are also described and illustrated. On pages 32 and 33 are shown rolling mill type of bed. Illustrations of instalations all over the world are shown.

Catalogue A illustrates and describes the refrigeration and ice making machinery. This neat catalogue shows the machinery and equipment necessary for the mechanical production of cold storage, giving detailed information and illustrations, making it a very useful publication.

HYGIENE LABORATORIES CALENDAR.

Five British bulldogs, embossed, forms the striking calendar picture on the Hygienic Laboratories, 11 Colborne St., Toronto. specialists in feed-water treatment, "We guarantee to do the work," is impressed upon the reader by the attitude of the bulldogs, the whole being an attractive idea, conveying the idea that the publishers intended it should.

KOLLOID-WOLFRAM LAMP.

Tungsten lamps show savings over other forms of lighting, and this is demonstrated in a folder issued by the Canadian Tungsten Lamp Co., Hamilton. In it are given comparisons of cost of the Kolloid Wolfram Tungsten Lamp and Carbon Lamps, the interesting figures showing a saving for the tungsten lamp of over 66 per cent.

JAMES MORRISON CALENDAR.

An engine room makes an attractive picture for an engineer. The engine room has been incorporated in a 1910 calendar issued by the James Morrison Brass Mfg. Co., Toronto. The figures are large and clear and can be seen at a distance from the opposite side of the engine room or office.

TUNGSTOLIER CO.

The Tungstolier Co., Toronto, has opened up offices at 96 King St. W,, suite 20, where they will have larger quarters for the demonstration of their apparatus.

The new offices will be equipped with apparatus for demonstrating correct and scientific illumination and the inspection of those interested. In correct illumination, a proper reflection and diffusion is as important as the type of lamp used.

R. B Basham, the general manager, has had twelve years' experience as a lighting expert, and is in charge of the Tungstolier Co., Toronto.

UNIFORM BOILER LAW.

At the conference of the representatives of the various Provincial Governments in Regina, John Peck, chief inspector of machinery for British Columbia, was elected permanent chairman and Mr. Quigley, secretary of the Board of Boiler Inspectors for Saskatchewan, was appointed permanent secretary.

On Jan. 18 a meeting of the British Columbia Board of Boiler Inspectors was held to consider the proposed new law. Any changes deemed advisable will be discussed at another meeting of the conference to be called later. Mr. Peck believes the act is a feasible one, and it is sincerely hoped that there will be no delay in the bringing about of a Uniform Boiler Construction and Inspection Act in Canada.

BOILER QUESTIONS.

How are old tubes taken out of a boiler, and what kind of a tool is used to take the tubes out?

How are new ones put in, and what kind of a tool is used?

Is any red lead used when putting in flues? Answers from other readers will be appreciated.—Subscriber.

THE POWER HOUSE IS MAKING GOOD.

Toronto, Nov. 25, 1909.

Mr. G. C. Keith,
Editor, "The Power House,"
Toronto, Ont.

Dear Sir,—Your favor of a special copy of "The Power House" to hand, for which I thank you, also for the prominence which you have given to Toronto No. 1 banquet.

"The Power House" is certainly making good as the best and ablest conducted paper in its line in Canada.

Enclosed is one dollar ($1.00) for one year's subscription to "The Power House."

W. C. TAIT.

Why "Heat" is Required in Mechanical Production of "Cold"

Power is Used in the Various Refrigeration Processes to Produce Low Temperatures—Boilers, Engines, Compressors, etc., being Required.

By GORDON C. KEITH

It is rather puzzling to those unacquainted with ice-making and refrigeration why power and heat are required in the mechanical production of low temperatures. The use of the word "cold" is rather unscientific and is a relative word meaning a lack of heat. To be more correct, "low temperature" is the proper and more scientific phrase.

Catalogues are issued explaining the systems of refrigeration and books are on the market explaining the thermodynamic theories of the action of various liquids in the production of cold. Perhaps engineers will best understand the system when they know that a refrigeration machine is a heat engine reversed. Compress a gas or vapor by some mechanical means and then relieve it of its heat so as to diminish its volume ; then cause this compressed air or gas to expand so as to produce mechanical work, and thus lower its temperature. The absorption of heat at this stage by the gas, in resuming its original condition, constitutes the refrigerating effect of the apparatus.

In other words, mechanical refrigeration is the process of reducing and keeping the temperature of a body or substance below the temperature of the atmosphere. In order to reduce the temperature of a body or substance it is necessary to employ a medium of a lower temperature, so that this medium will absorb the heat from the body or substance when brought into close contact with it. Such liquids as have a low boiling point are used for this purpose.

The gases and vapors generally available are : sulphic ether, sulphurous oxide, ammonia, methylic ether and carbonic acid.

In the absorption system heat is applied directly through the agency of steam. In the compression system it is applied either through steam which is required to operate the engine which drives the compressor or through steam used in the generating unit furnishing power to the compressors.

Specific Heat.

The substances mentioned have a definite capacity for absorbing heat. Pure water at the point of greatest density 39.1 degrees Fah. The British thermal unit is the quantity of heat required to raise the temperature of one pound of water from 39 degrees to 40 degrees Fah. Other substances absorb heat in a similar manner. There is a definite relation between water and other substances and this relationship or ratio is known as the specific heat of the substance.

If one British thermal unit of heat is added to air, a little over four pounds of air are raised one degree. The relationship between air and water is that air requires .2375 of a thermal unit per ℔. of air, that is, the specific heat of air is .2375.

Air measures about 13.14 cu. ft. to the pound, so that 52.5 cu. ft. of air will be raised one degree Fah. by the application to it of one British thermal unit.

The Polar Winds.

Perhaps the best illustration of refrigeration principles is shown by the polar winds which rush from the poles towards the equator. Heat passes from a body at a higher temperature to one at a lower, so that heat is transferred from the warmer earth to the cooler rushing air. These cold winds abstract heat from everything in their path, leaving frozen lakes and large quantities of snow as a result. Canadians should understand the effect of a wind from the north during the winter months.

Flue Gases.

Another example is that of the flue gases. These are heated by the fuel. They strike against the boiler plate, thus transferring the heat to the water of the boiler. The steam in turn transmits steam to the engine, and so on. The absorption of heat by the flue gases gives them the power to do work and this power is transmitted through water, steam, etc. As in the case of the polar winds, only in the reverse manner, heat is abstracted, or is transmitted to the cooler body, leaving the flue gases cooler. A certain definite quantity of heat is transferred to the boiler to produce steam.

In refrigeration a certain amount of heat must be abstracted to lower the temperature of a substance. To cool water from 70 degrees F. to 32 degrees F., 38 B.t.u. must be abstracted from each pound of water. As a gallon of water weighs ten pounds, .380 B.t.u. must be abstracted. This is accomplished by passing a fluid near the water to be frozen, thus consuming power which is generated by heat. It will be seen, therefore, that even this far heat is required in the production of lower temperatures.

Latent Heat

To produce one pound of water at 32 degrees Fah. from one pound of ice at 32 degrees Fah. requires the consumption of 142 B.t.u. Similarly let us take a pound of water at 32 degrees F. and in changing it to ice at 32 degrees F. we find that 142 heat units must be taken from it before it becomes solid, although the temperature, by the thermometer, remains the same, therefore the latent heat of ice is said to be 142.

Power Required.

In the use of carbonic acid, ammonia or carbonic acid to extract heat from air or water, the substance is allowed to expand in a coil of pipes, it is then caused to pass to the compressor, thence to the condenser where it is liquefied, and again sent through the coils where it again expands, etc., throughout the cycle again. All this consumes power.

When the liquid carbonic acid expands in the coils it extracts heat from the air in the cold chamber, or from the brine with which the coils containing the gas are in contact. The passage of heat to the carbonic acid causes it to expand and an equivalent amount of work must be done upon it to reconvert it into a liquid. This is accomplished in the compressor. The power consumed by the compressor piston represents the work done upon the gas, neglecting the work done to overcome the friction of the piston.

The gas is liquefied in the condenser just as the steam is condensed into water. The latent heat of gas is abstracted and also the heat imparted to it by the compressor. Power is consumed in pumping water through the condenser.

In systems where brine is used, power is required in pumping brine through the coils. This brine is usually a solution of calcium chloride and salt, which has a lower freezing point than water. Where the cold air is circulated by fans, power is consumed in driving the fans.

The quantity of power depends on the size of the plant, the system used, friction in pipes both in condenser and circulating coils, etc. The friction of gas against walls varies about as the square of the speed at which the gas is flowing. With a back or suction pressure of 15 ℔s., condenser pressure of 150 ℔s., cooling water for ammonia condenser at 60 degrees, a 5 x 8 refrigerating machine, 100 r.p.m., 2 tons per 24 hrs. capacity, requires 5 h.p. motor for condenser, 8 h.p. of boiler, 240 gals. water per hour for condenser and 22 gals. of water per hr. for boiler. This serves as an illustration of the quantity of power used.

Cold Air Continuous Circulation System of Refrigeration

System is a Result of a Number of Experiments by Prof. Carl Linde—A Desciption of the System with Illustrations Showing the Application of It.

By F. C. D. WILKES, B.Sc.

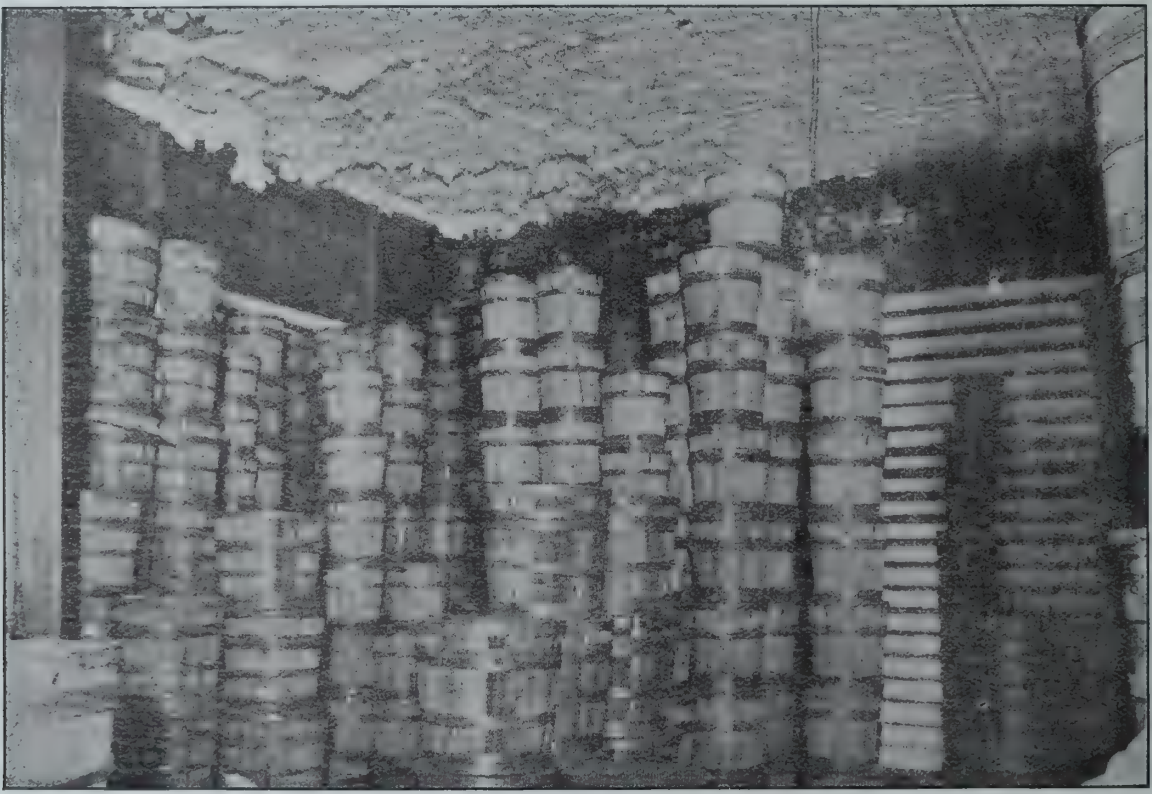
This system of refrigeration, by means of the continuous circulation of cold air, was first put to practical use by Prof. Carl Linde after a long series of experiments made by him. It is the outcome of his dissatisfaction with the systems involving great lengths of pipes and the necessity of lofts above the rooms. Another of the difficulties which he wanted to overcome was the accumulation of ice and snow on these pipes which results in decreased efficiency and slower operation. Materials stored were also affected from the dampness experienced in the rooms and the accumulation of foul gases rising from the goods was a source of contamination and often ruined the insulation.

Thus it will be seen that the main goal was ventilation. Where expansion or brine pipes are used for the cooling of the rooms, the rooms are seldom if ever ventilated and the air remains the same except for the small amount of fresh air which enters when the doors are opened. The tendency is for all gases and odors, which arise from the goods or freshly killed beasts, to remain in the rooms, mix with the air and if not removed condense again on the goods affecting their condition. The walls and insulation also receive these condensed gases which make them slimy and finally hasten decay. The question of ventilation has been rather a difficult one and it seems only natural that the cold air circulation system should be the result of efforts in this direction.

As Prof. Linde was the pioneer of this system it is his which I will describe here. This system makes use of a circulation of chilled air to the rooms to be cooled, this air having had its temperature lowered in its passage through a closed room known as the air cooler. This cooler is connected to each of the chill rooms by means of air ducts and a fan keeps up the circulation. The expansion coils are suspended over a shallow wrought iron tank which is filled with brine. From this tank a pump draws the brine, forces it to a header above the pipes which distributes it in a continuous shower over the pipes. The fan drives the air through the brine and over the pipes and as the surfaces are kept clean and the brine is clean and cold the heat of the air is given up very rapidly. The passage of the brine over the expansion pipes keeps them always clean and free from ice and snow. The air is thoroughly washed in passing through the cooler and any impurities which are contained in the air are absorbed and destroyed by the action of the sodium chloride or salt.

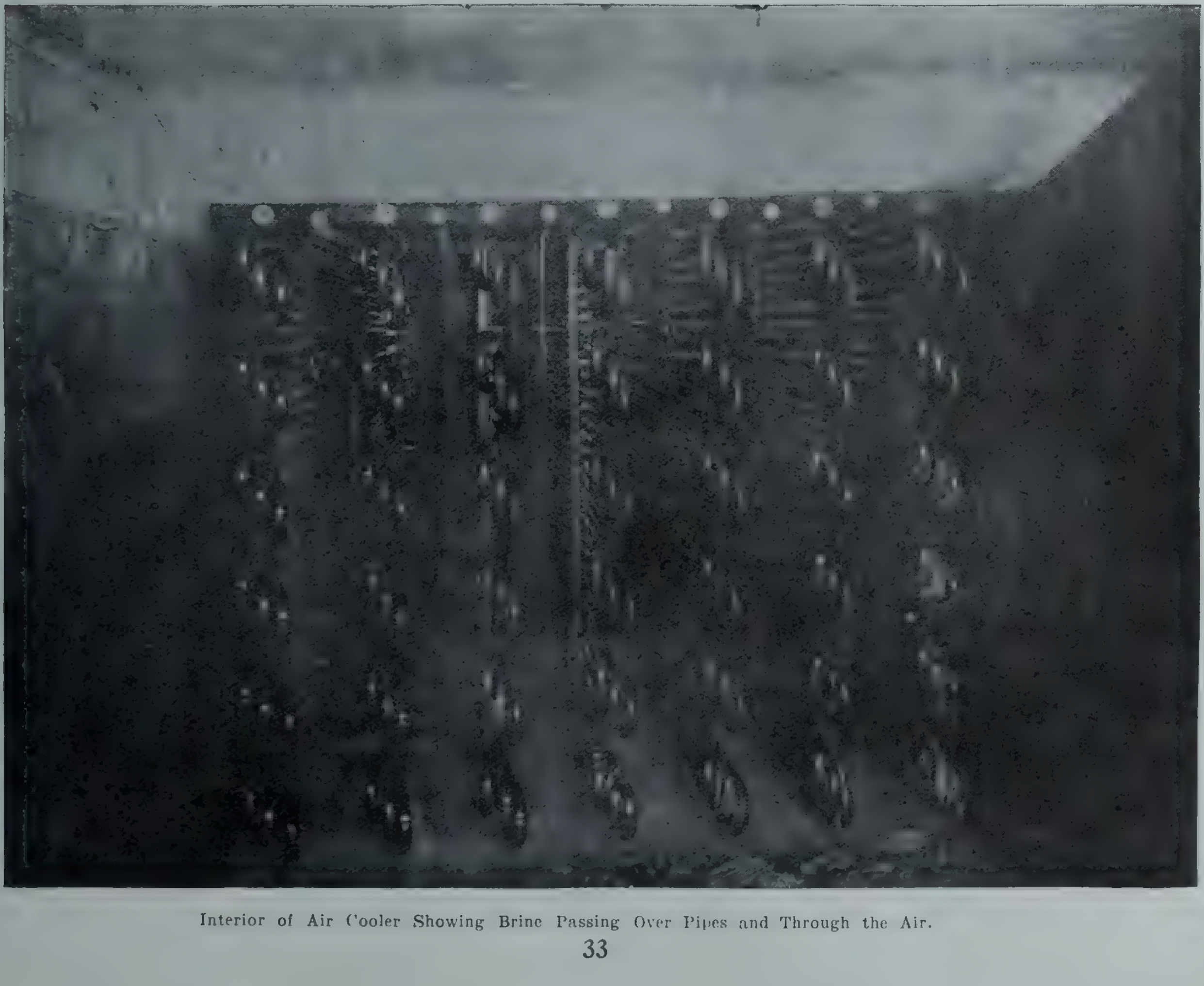
It has been claimed that the continuous circulation of the air would increase the shrinkage of the goods, tending to dry them more. At first glance this would appear to be true, but what is actually the case, in a well run system, the shrinkage is decreased. Let us reason this out. Having always clean surfaces in the coolers results in only a small difference in temperature between the brine and the air. Thus the air is not able to give up much moisture and consequently has but little power of absorption in passing through the chill rooms.

Naturally the brine absorbs some moisture from the air and consequently gradually increases in quantity and decreases in strength. The liquid is concentrated by boiling and reurned to the tank. This boiling process not only concentrates the liquid, but drives off



Showing Ice and Snow in Room Chilled With Pipes.

Showing Arrangements of Air Ducts.



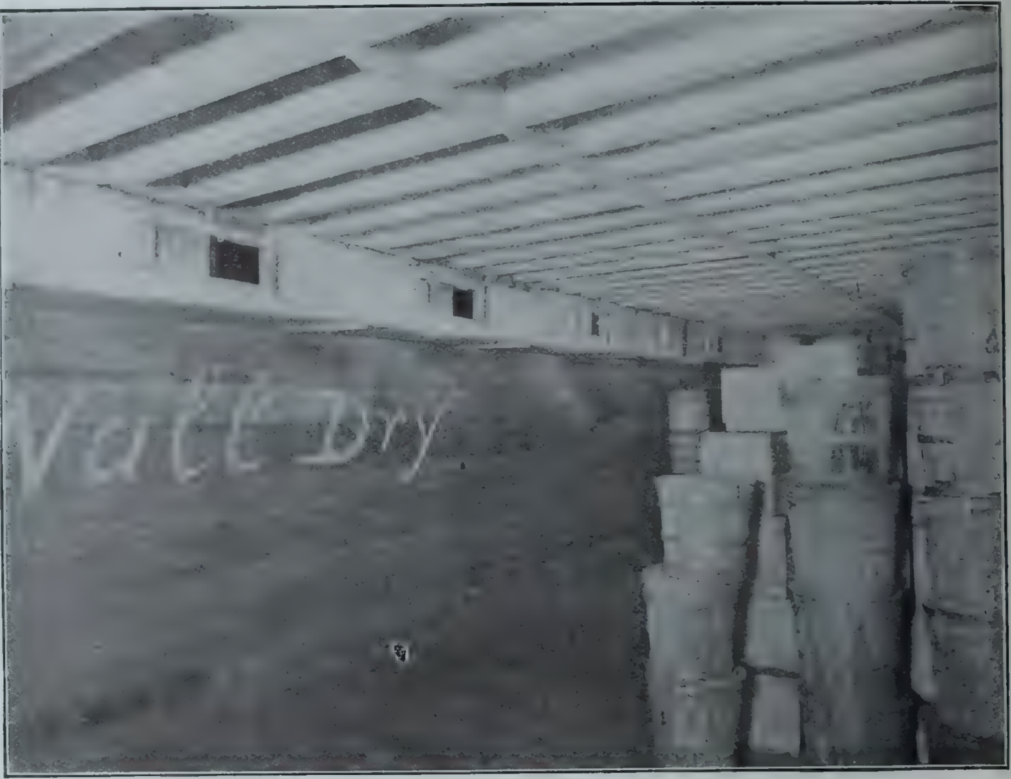
Interior of Air Cooler Showing Brine Passing Over Pipes and Through the Air.

the impurities. This sterilizing process occurs with varying frequency depending upon the amount of fresh material placed in storage and is accomplished in a most economical way. When the amount of brine in the circulating tank has been augmented by sufficient moisture from the air it goes into a second or storage tank. From this it is pumped to a third tank in which it is boiled by means of a steam coil, the excess of moisture and the impurities being given off. A considerable saving in fuel, water, packing and oil is effected by running this warm, concentrated brine through a coil in the storage tank where it gives up some of its heat to the brine awaiting purification.

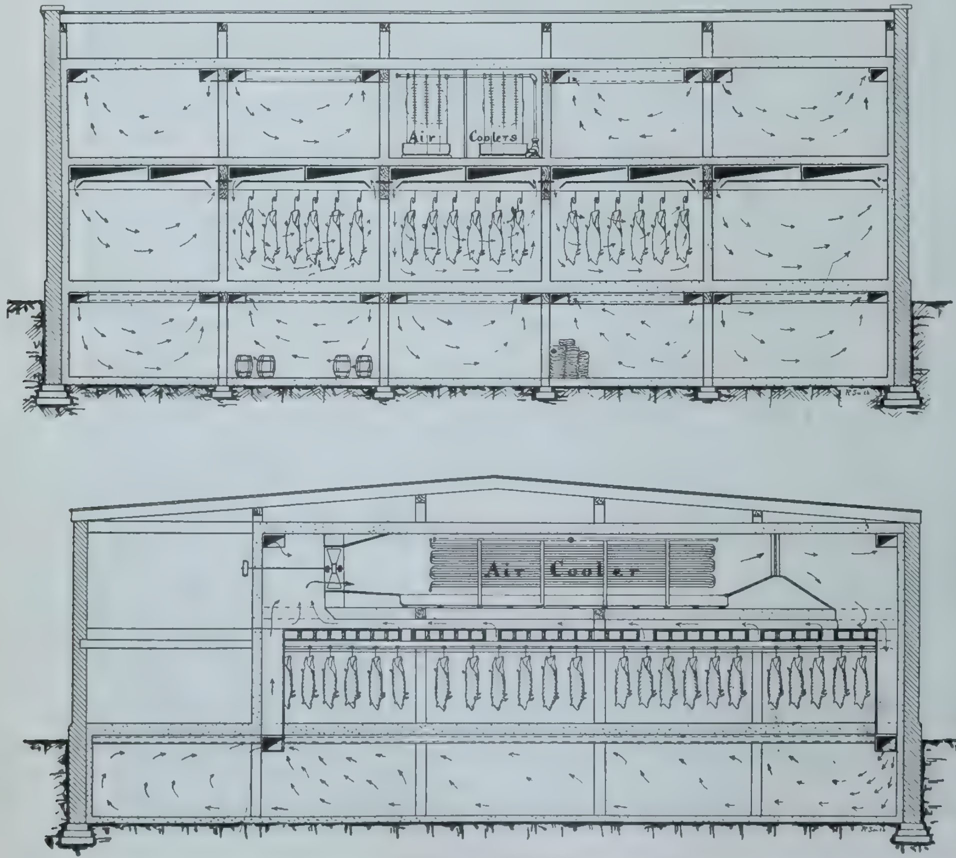
The air ducts are constructed of tongued and grooved boards, from $\frac{3}{4}$ inch to 1 inch thickness and, to economize on material, are generally placed along the corners under the ceiling so that the wall and ceiling form two sides of the duct. The outlets for the cold air are on the bottom of the duct, while those for the exhaust air are placed as closely as possible to the ceiling. The openings are provided with slides placed at intervals, the regulation of which makes the air delivery uniform.

Where high and low temperatures are desired, such as occurs in large cold stores, it is advisable to have two separate coolers or more. In this way the temperatures of the air and brine may be kept more nearly equal and the loss due to shrinkage will be reduced to a minimum. However, different temperatures may be kept in different rooms even with the one cooler. This is accomplished by regulating the amount of flow by means of the slides.

Of course there are instalations where the cold air system would not be advisable and where it is necessary to use the pipe system. The principal advantages claimed for the cold air systems look rather formidable and include the following: The construction is simple; after the cooler has been set up there are no pipes to fit throughout the building. The desired temperature in the room may be arrived at more rapidly on account of the fact that the air can be forced, and by the reason that while heat can be dissemated more effectively by connection than by radiation the reverse also holds true. The entire absence of ice or snow is another of the great advantages of this system; the goods are kept in a better condition; there is less space needed and more can therefore be given over to chill rooms.



Air Cooled Room Showing Dryness of Wall.



Showing Arrangement of Cooler.

A USEFUL SOUVENIR.

The Armstrong Machinery Co., Station B, Spokane, Wash., manufacturers of and dealers in refrigeration supplies, are remembering their friends with a very useful souvenir in the shape of a combination pen and pencil. On it is printed the slogan: "An authentic reproduction of the North Pole. For a 'perfect frost' at a minimum cost, order a Spokane or Alaskan ice machine."

Fred C. Gibbons, managing director of the Browett-Lindley Co., Manchester, Eng., manufacturers of high speed engines suitable for street railway service and electric lighting plants, has been visiting Canada. He made arrangements with E. Leonard & Sons, London, to act as their sole agents in Canada.

Items Entering into Cost of Manufacturing Ice[*]

By A. P. CRISWELL

It is impossible to estimate, even approximately, on the cost of operating any kind or size of ice plants anywhere without accurate knowledge of the local conditions under which the plant is to be operated. All of the several items that go to make up the cost of operation : labor, fuel, water, oil, waste and incidentals, ammonia, salt, depreciation and repairs, insurance and taxes, and interest on the investment, have different values in different localities.

Labor estimates that would seem very high in small towns would be conconsidered low in large cities. Coal is obtainable in many localities at a cost of $1 to $1.50 per ton, while in others it costs from $3 to $4 per ton and in some foreign countries $10 and upwards.

Water can generally be had for the pumping, but in some instances the cost of this item alone, particularly where no cooling tower is used, may add from 40 cents to 50 cents per ton to the cost of making ice. Even at the price figured in the table (5 cents per 1,000 gallons) the cost of water will be 25 cents per ton of ice if no effort is made to save it ; but it is presumed that no one will be so stupid as to operate an ice making plant without a cooling tower where water must be paid for, and these estimates are based accordingly on using the water over and over for cooling purposes, allowing 20 per cent. of the total amount for loss by evaporation—waste and water actually used for making ice—and this is amply sufficient to cover all necessary losses, provided water can be recovered from the cooling tower at a temperature not to exceed 70 to 80 deg. F. In winter the amount of water may sometimes be reduced by 50 per cent or more and in very hot climates the amount required may be doubled.

Oil, waste and engine room supplies will vary only slightly in cost, for different cities. Anhydrous ammonia costs from 25 cents to 30 cents per pound in large cities of the United States, while this cost may be more than doubled in some foreign countries. Salt varies considerably in cost and quality, ranging from $3 to $10 per ton, but it will be seen that this item does not enter largely into the cost of ice ; the quantity actually used being comparatively small.

Depreciation and repairs will depend principally on the kind and cost of buildings and plant and on the care taken of them. Insurance and taxes will vary considerably and will depend on the cost of buildings and plant, and on the cost of site as well. Interest on the investment is figured on the basis of average conditions prevailing in the towns and cities of the United States, and the fact that small plants are generally wanted only in small towns where land and labor are cheap, and large ones in large cities where land and labor are expensive, has been carefully considered.

For convenience the interest has been figured at five per cent. for 360 days so that it is necessary only to multiply the interest item by 360 and this product by 20 to arrive at the estimated cost of any given plant. Or, as 260 by 20 plus 7200, multiply the interest item by 7200 and cut off two ciphers. The result will give the estimated cost of the plant in even dollars. For instance, the interest per day on a 5-ton plant is $1. This multiplied by 7200 gives $7,200 as the approximate cost of the plant with buildings and site in a small town. The interest on a 120-ton plant is $18.00. This multiplied by 7200 equals $129,600, approximate cost of the plant in a large city.

I desire to make it perfectly clear that this table is intended to show, approximately, the average costs of making ice in average can plants when operated at normal capacities under the conditions named.

My object in presenting this paper is to call attention to the single item where we may hope for improvement. A study of the table shows that the average cost, per ton, of all labor is about 36 cents ; the cost of fuel 50 cents ; water 5 cents ; ammonia 5 cents ; salt 1 cent ; oil 1 cent ; sundries, waste, etc., 1 cent ; depreciation and repairs, 10 cents ; insurance and taxes 10 cents, and interest on the investment 15 cents. We can hope for very little reduction in the labor account. The other items, with the single exception of fuel, are practically con-

APPROXIMATE COST OF MAKING ICE WITH PLANTS OF DIFFERENT SIZES OPERATING UNDER SIMILAR CONDITIONS (By A. P. Criswell, Chicago).

Ice in Tons per Day of 24 Hours.	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	110	120
Engineer, day (cents)	210	230	250	270	290	310	330	350	370	390	415	440	465	490	515	540	565
Engineer, night	200	210	220	230	240	250	260	270	280	290	305	320	335	350	365	380	395
Tankman, day		150	160	165	175	190	190	210	210	220	250	(2)380	400	420	440	460	480
Tankman, night			150	160	170	190	190	210	210	220	250	(2)380	400	420	440	460	480
Fireman, day				175	175	190	195	205	210	225	250	250	250	275	300	300	300
Fireman, night					175	190	190	205	210	225	250	250	250	275	300	300	300
Laborer, day							150	150	155	165	175	175	175	175	200	200	200
Laborer, night									155	165	175	175	175	175	200	200	200
Oiler, day											150	150	175	195	220	220	220
Oiler, night													175	195	220	220	220
Extra Man, day																240	240
Extra Man, night																	240
Fuel, Coal @ $2.50 per ton.	250	500	750	1000	1250	1500	1750	2000	2250	2500	3000	3500	4000	4500	5000	5500	6000
Water, @ 5c per 1000 gals. (20% of).	25	50	75	100	125	150	175	200	225	250	300	350	400	450	500	550	600
Ammonia, @ 30c per pound.	25	50	75	100	125	150	175	200	225	250	300	350	400	450	500	550	600
Salt, @ $5.00 per ton.	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	110	120
Oil, all kinds	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	110	120
Sundries, Waste, etc.	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	110	120
Depreciation and Repairs.	50	100	150	200	250	300	350	400	450	500	600	700	800	900	1000	1100	1200
Insurance and Taxes	50	100	150	200	250	300	350	400	450	500	600	700	800	900	1000	1100	1200
Interest.	100	160	225	300	375	450	525	600	675	750	900	1050	1200	1350	1500	1650	1800
Cost, per day—Total.	925	1580	2250	2960	3675	4260	4935	5520	6160	6800	8100	9380	10640	11790	13000	14300	15600
Cost per ton—Total	185	158	150	148	147	142	141	138	127	136	135	134	133	131	130	130	130

NOTE.—It is presumed that cooling tower, saving 80 per cent of the water required for cooling purposes, will be used where water must be paid for.

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[*] Paper read at American Society of Refrigerating Engineers' meeting.

stant and no material reduction can be made in any of them. I believe it is easily within the range of possibilities to reduce the fuel expense by 50 per cent. by the use of high class boilers and engines, mechanical stokers, fuel economizers, water purifiers and smoke consumers provided the purchaser is willing to pay the price for a strictly first class plant. Where water conditions are favorable the plate system, or better, a combination of the plate and can system is, in my opinion, advisable; the combination plant being so proportioned that the steam required to operate both systems will furnish the necessary distilled water for the can system and no more. This would add perhaps, one third to the cost of the installation, thus raising the interest account by five cents per ton, leaving a net gain of 20 cents per ton, or about 15 per cent.

I have been requested to give the additional cost per ton when the plant is operated only six months per year or 180 days running time. In answer I will say that the table is arranged so that any one may figure the cost of making ice for any given time. When the plant is shut down, practically all of the expenses may be cut out with the exception of the last three items—depreciation and repairs, insurance and taxes and interest on investment. The first of these is estimated to cover the necessary repairs to keep the plant in first-class condition always, and if the chief engineers and one or more of his assistants are retained during the time the plant is shut down their salaries may be charged against depreciation and repairs account, as the work they do will cut down that item accordingly. But these three items must be figured for the entire year and this amount for the time of shutdown must be added to the expense while running and the total amount divided by the tons of ice made to get the total cost per ton for the entire year. Even in the case of a plant running only half the time the result is not so alarming as, at first thought, it seems, but we cannot get away from the fact that it adds to the cost about 35 cents per ton of ice made. Take for instance the 100-ton plant, the total cost per day is $130, or $23,400 for 180 days; the cost for the last three items is $35 per day or $6,300 for 180 days, a total of $29,700 for 360 days, while the total output is 100 tons for 180 days or 18,000 tons, equal to $1.65 per ton.

In this connection I wish to warn the trade against a certain class or fakirs and dreamers who bob up from time to time with so-called "New Processes" by which they claim to be able to make merchantable ice at a cost of 50 cents per ton. These claims will not bear the test of expert investigation, and nine times out of ten it will be found that the inventors are more anxious to sell stock in their get-rich-quick schemes than to put their inventions to a practical test.

Feed Water Treatment Dicussed at Toronto C.A.S.E.

Prof. Bain of Toronto Discussed the Treatment, Giving Costs. The Continuous and Intermittent Methods were Described and uses of Limewater

An open meeting of the Toronto Lodge No. 1, C. A. S. E., was held on Jan. 21, when Prof. Bain of Toronto University gave an instructive address on feed-water treatment.

Prof. Bain referred to the CO_2 recorder and the different scale-forming constituents of water, limestone, carbonate, not very soluble; bi-carbonate of lime containing more CO_2 causing hard water and is soluble; and gypsum, sulphate of calcium, soluble in water, etc.

Boiling, he said, is the first method of softening water, and therefore we have the feed-water heater, which lessens the scale that gets into the boiler. Simple water heating costs about 80 cents per 1,000 gallons if used in large quantities, such as textile mills and railroads.

To water in which hardness is temporary, that is, in which there is bi-carbonate of lime, add lime water, and scale-forming constituents are precipitated. This is the idea of Dr. Clark who in 1841 used this method.

When water has a permanent hardness boiling does not remove it, and lime method cannot be used. In 1876 another method was devised, which is used to remove permanent hardness. To precipitate permanent hardness use sodium carbonate, washing soda, $Ca\ CO_3$.

Intermittent Method.

Two methods of removing scale-forming constituents are used, intermittent and continuous. In the intermittent method limewater and soda are put into one tank. Two tanks are used, the tanks being used alternately. Sludge is removed through manhole by flushing with hose. In practice milk of lime is used, it being more efficient and less expensive.

Continuous Softener.

In the continuous method a large cone 60 to 80 ft. high and 60 ft. diam. is used. The sludge is drawn to centre of water. The water is pumped into the softener at the bottom, allowed to remain twenty-four hours, and is taken out at the top. There are usually two cones, one inside the other, so that the water is at rest. Twenty-five per cent. of the coal bill may be saved by softening water.

Feedwater Treatment.

Sodium carbonate costs $1.10 per 100 lbs. in barrel lots. Feed it in with feed-water, and it deposits a great deal of scale-forming constituents.

Tri sodium phosphate is better as a precipitant, but costs 6 cents per lb. Do not put lime in a boiler, as it forms scale.

Where oil is put in there will be trouble. Oil forms a greasy layer and lowers the heat transmission. A very thin layer of oil on the boiler plate means a great loss of heat. Therefore avoid oil.

Sal ammoniac made by adding Hcl and ammonia, are dangerous at high pressures. If they separate, as they will under high pressure, the muriatic acid will attack the boiler. This trouble is eliminated by using alkali compounds.

If boiler corrodes badly, feed soda regularly. Scale lowers efficiency. One-quarter inch will lower the efficiency about 15 per cent. In Ontario, and more especially in the western part of the province, there is a great opening for filters and softeners on account of the vast gypsum and lime deposits. Stationary plants, therefore, must soon follow the lead of the railroads and install water softeners to remove the scale-forming constituents of water.

In using compounds, it is best to have a scientific analysis made of the boiler feed-water. Only by having a proper prescription, by using the proper compound will it be of use to the feed-water in removing the scale-forming ingredients in it.

Cost of Softening.

Using the continuous system, it costs 1½ to 2 cents per 1,000 gallons to remove hardness from water. The average cost of 11 railways in United States was 6½ cents per 1,000 gallons, which covered interest on investment, etc.

Chemical Explanation.

Natural waters which come in contact with limestone gradually take up more or less of the carbonate, because of the carbon dioxide dissolved in them.

$Ca\ O$=lime.

$Ca\ CO_3$=calcium carbonate.

$Ca\ O+H_2O=Ca\ (OH)_2$.

$Ca\ (OH)_2$=calcium hydroxide.

$Ca\ CO_3+H_2O+CO_2=Ca\ H\ (CO_3)_2$.

$Ca\ H\ (CO_3)_2$=sodium bi-carbonate.

$Ca\ H\ (CO_3)_2+Ca\ (OH)_2=2\ Ca\ CO_3+2\ H_2O$.

$Ca\ CO_3$ is insoluble and is precipitated.

The Cold Storage Act and Subsidies for Cold Storage

Act Provides for Thirty Per Cent. Subsidy Covering Cost of Building and Equipment Regulations—Comments by J. A. Ruddick, Dairy Cold Storage Commissioner

His Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows :—

1. This Act may be cited as the Cold Storage Act.

2. The Governor in Council may enter into contracts with any persons for the construction, equipment and maintenance in good and efficient working order, of public cold storage warehouses equipped with mechanical refrigeration, in Canada, and suitable for the preservation of all food products.

3. The location, plans and specification of every such warehouse, its equipment, and the amount to be expended thereon, shall be subject to the approval of the Governor in Council.

4. The Governor in Council may, out of any moneys appropriated by Parliament for the purpose, grant towards the construction and equipment of any such warehouse a subsidy not exceeding in the whole thirty per cent. of the amount expended or approved of in such construction and equipment, and payable in instalments as follows : upon the warehouse being completed and cold storage at suitable temperatures being provided therein, all to the satisfaction of the Minister of Agriculture, a sum not exceeding fifteen per cent. of the amount so expended ; and at the end of the first year thereafter seven per cent. of the said amount, at the end of the second year thereafter four per cent. of the said discount, and at the end of each of the two next succeeding years two per cent. of the said amount : provided the warehouse is maintained and operated to the satisfaction of the Minister of Agriculture.

5. The Minister of Agriculture may refuse to pay any part of the said subsidy if, in has opinion, the operation of the warehouse has not been of such a character as to provide for the proper preservation of such products as may be stored therein.

6. The Minister of Agriculture may order, and caused to be maintained, an inspection and supervision of the sanitary conditions, maintenance and operation of such warehouses, and may regulate and control the temperatures to be maintained therein in accordance with the regulations to be made as hereinafter provided.

7. The rates and tolls to be charged for storage in such warehouses shall be subject to the approval of the Governor in Council.

8. For the effective carrying out of the provisions of this Act the Minister of Agriculture may appoint inspectors, who shall have access to all parts of such warehouses at all times.

9. The Governor in Council may make such regulations as he considers necessary in order to secure the efficient enforcement and operation of this Act; and he may by such regulations impose penalties not exceeding fifty dollars on any person offending against them ; and the regulations so made shall be in force from the date of their publication in The Canada Gazette, or from such other date as is specified in the proclamation in that behalf.

10. Chapter 7 of the statutes of 1897, intituled an Act respecting Cold Storage on steamships from Canada to the United Kingdom and in certain cities in Canada, is repealed.

Regulations.

Whereas by section 9 of the Cold Storage Act it is provided as follows :

"The Governor in Council may make such regulations as he considers necessary in order to secure the efficient enforcement and operation of this Act ; and he may by such regulations impose penalties not exceeding fifty dollars on any person offending against them ; and the regulations so made shall be in force from the date of their publication in The Canada Gazette, or from such other date as is specified in the proclamation in that behalf."

Therefore His Excellency the Governor General in Council is pleased, in virtue of the above cited provisions of the said Act, to make the following regulations, the same to come into force on the date of their publication in The Canada Gazette.

1. The Minister of Agriculture may make appointments of inspectors and other persons for the enforcement of the Act.

2. No application shall be considered for any cold storage warehouses except those equipped with mechanical refrigeration, nor for any place where any such cold storage already exists or where the proposed cold storage would compete directly with other establishments of the same class.

3. Applications for a subsidy under the Act must be made in the following form, which shall be known as Schedule A.

Application for Cold Storage Subsidy

Application is hereby made on behalf of ....of ....in the province of .... for the subsidy offered under The Cold Storage Act for a public cold storage warehouse equipped with mechanical refrigerating machinery to be erected at ....

Particlars.

Size of building in cubic feet..............

Refrigerated space in cubic feet ....

Number of separate chambers............

Kinds of produce to be stored ....

System of mechanical refrigeration to be used. ....

Capacity of refrigerating machinery in tons of refrigeration per 24 hours......

Character of the available water supply ....

Estimated cost of building, equipment and water supply. ....

Cost of site ....

Will the whole building be used for the purposes of a public cold storage?...

If not, what proportion will be set aside for public use ? ....

Attached are the following documents.

Exhibit 1, being a copy of the plans and details of the insulation of warehouse in triplicate.

Exhibit 2, being a true copy of the specification of warehouse and insulation in triplicate.

Exhibit 3, being schedule of rates to be charged.

Exhibit 4, sketch showing location of warehouse or proposed warehouse in regard to connection with railway lines and wharfs.

4. The owners of cold storage warehouses in order to secure the subsidy, will be required to maintain the following temperatures therein, for the preservation of the various products mentioned.

Kinds of Produce.	Temperature. Min.	Temperature. Max.
Apples and other fruits	32	36
Butter	...	20
Cheese	35	40
Eggs, meats and dressed Poultry	30	34
Bacon and Hams	40	45
Fish (Frozen)	...	20
Meats, Poultry and Game, (Frozen)	...	20
Vegetables	34	38

5. Nothing in these regulations shall prevent owners of subsidized cold storage warehouses from entering into special contracts with customers for maintainence of temperatures other than those herein specified.

6. The first instalment of the subsidy shall not be paid until the applicant shall have presented proper vouchers for

the cost of building, equipment, site and other expenditures.

7. The owners of cold storage warehouses to which the subsidy or any part thereof has been paid, may be required to make an annual report to the Minister of Agriculture in such form as may be prescribed.

Comments.

By J. A. Ruddick*.

There is no country in the world to which cold storage is of more importance than it is to Canada. The large and growing production of perishable food products, and the long distances from market not only for export trade, but for internal trade as well, make the employment of artificial means a necessity for prolonging the life of a large quantity of produce, if it is to reach the consumer in prime condition.

In these days of progress and strong competition from the ends of the earth, the standards of quality are constantly being raised and the facilities which were adequate a few years ago are no longer sufficient to meet the present needs of the situation.

The prairie provinces of Canada will soon have a large population which will have to be supplied with fruit from the other provinces, or from the United States. Proper cold storage facilities will assist Ontario and British Columbia fruit-growers to compete with others in supplying this great market.

Cold Storage for Butter.

The export creamery butter is now well taken care of at Montreal, and is mostly shipped to cold storage warehouses in that city direct from the creameries. There is, however, much room for improvement in the manner in which the large output of dairy butter is handled, especially that which is intended for home consumption. Half a cent a pound will carry butter in cold storage for several months, and a proper use of cold storage would undoubtedly add more than that amount to the value of the greater part of the dairy butter which is produced in Canada.

Cold Storage for Cheese.

Export cheese is for the most part cold stored at Montreal, and there is not likely to be much change in this respect, unless it be a tendency to store more on the other side of the Atlantic. There is, however, a growing business in storing cheese for home consumption, and when Canadians learn to eat cool cured cheese, say at least six months old, the business will grow still faster.

Cold Storage for Poultry.

The business of growing and fattening chickens, and other poultry, can be very materially assisted by the use of cold storage. Without such facilities, the killing must be posponed until cold weather sets in, and mistakes are frequently made in killing too soon with serious financial loss. Cold storage makes the poultry farmer independent of the weather, and the fattening season can be considerably extended by beginning earlier.

Cold Storage for Fruit.

The fruits of Canada are noted for their tender, luscious qualities, which is synonomous with saying that they require careful handling and protection, to check the rapidity of their life processes, as compared with the dryer and less juicy fruits grown in other climates.

There is no food product grown in Canada which comes within the perishable class, to which the use of cold storage can be applied with more benefit than it can be to some of the fruits. The apple is Canada's most important fruit, and not the least dependent upon cold storage if the most is to be made out of the crop. Every farmer who keeps a few barrels of apples for his winter use, recognizes the effect of cold storage in prolonging the life of his apples, by keeping them in a cellar which will be as cold as possible without freezing. What is not so generally recognized is the fact that low temperatures are most effective to this end if the apple is placed therein immediately after being taken off the tree. When this course is adopted, the ripening process is checked at a time when it would naturally proceed very rapidly, especially as the warmest weather to which the apple will be exposed is likely to prevail at the time the crop is being harvested. A few days' cold storage at this stage is of more value than as many weeks later on. There are districts in Ontario, admirably adapted for the growing of apples, but where the length of the warm season frequently causes great loss and discouragement to the grower, by carrying the apple to a stage of maturity which interferes seriously with its keeping quality. Cold storage would be of especial benefit to the apple grower in such localities.

For these reasons it is obvious that the proper location for a cold storage warehouse, intended for apples, is as near to the point of production as possible.

The great bulk of apples in relation to value, as compared with some other products, is a practical difficulty from the warehouseman's standpoint, because he finds it hard to get remunerative rates. Further, the season is short and other goods are not always to be had in the interval, particularly in a district devoted to fruit growing. The solution of the difficulty would appear to be to organize the cold storage business on such a basis that it would be credited with a part at least of the enhanced value of the apples, and the logical suggestion is that there should be some form of co-operation among the fruit growers to carry out the idea.

General.

The foregoing are some of the considerations which prompted the Government to adopt the policy of subsidizing new cold storage warehouses.

The provisions of the Cold Storage Act have been drafted with a view of securing safe storage for perishable farm products in districts not at present provided with such facilities. The requirements of trade in certain localities has made cold storage an absolute necessity, and in such places the revenue is sure enough to make the investment a fairly safe one, so that it needed no special inducement to secure the capital required to provide the necessary facilities.

There is no intention of giving the subsidy to any business which will come into direct competition with others already established. While it may, at first glance, seem a little unfair to assist the new enterprises, even if noncompetitive, it must be borne in mind that the existing cold storage warehouses occupy the choice locations, and for that reason some inducement seems to be necessary if similar facilities are to be provided in other localities.

There is a large quantity of perishable produce handled in this country without cold storage, the value and stability of which would be much improved by its use. Where it is possible to get along without cold storage, even if the results are unsatisfactory, the question is not studied so closely, and the improved facilities come more slowly, than is the case where the necessities are greater. It is hoped that the attention which has been drawn to the subject by the adoption of the principles involved in The Cold Storage Act, and the discussions which will naturally arise thereon, will have an important educational influence in the direction of creating a more general appreciation of the advantages of cold storage and a greater demand for such facilities. It is believed also that this process of education will result in bringing more business to existing cold storage warehouses.

Application for Subsidy.

Any person, firm or corporation desiring to take advantage of the provisions of the Cold Storage Act, will be required to furnish full particulars, as provided for by Order in Council, and the necessary blank forms will be supplied by the Department of Agriculture on application to the Dairy and Cold Storage Commissioner.

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* Dairy and Cold Storage Commissioner.

PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

WEIGHT OF ICE.

It is customary to figure from 40 to 50 cubic feet for a ton of ice, house measurement. By house measurement is meant the inside dimensions of the ice storage room. Where the house is small and the ice is packed in sawdust or other packing material in the old fashioned way, it is customary to allow about 50 to 55 cubic feet for a ton of ice; in larger houses less in proportion.

In the modern houses such as are used in connection with modern cold storage systems no packing material is used either in the sides or on the top as the walls, floor and ceiling are thoroughly insulated. In such a house 40 cubic feet is ample to allow for a ton of ice.

Forty cubic feet is the figure which has probably been used more than any other in connection with the storage of natural ice for retail purposes. This allows for packing every third tier at least on edge. It takes a little more space where part of the ice is packed on edge.

The actual space occupied by a ton of solid ice is only about 35 cubic feet, so you will see that all of these figures are simply estimates to allow for loss of space from various causes when packing the ice in the house.—Cold.

ICE MAKING TROUBLES.

By H. L. Vinton.

On taking charge of a 50-ton ice plant the proprietor asked me to take a look at the ice and tell him what I thought of it. He had not had good ice since the new reboiler and cooling coils had been installed. I found the ice was full of air and had a large red streak running through the centre. I started in by getting some lye and cleaning out the re-boiler. After this, I removed the steam coils and scraped them, also cleaned the skimming tank and cooling coils. I found the charcoal in the filters as fine as sawdust and full of grease and a red substance. When I asked for a new charge of charcoal I was informed that new charcoal had been placed in the filters two seasons before and consequently did not need a new charge. I was supposed to take the old charge out and wash it, which I did not do but cut the filters out of service.

On starting up the plant again, I was sadly disappointed for the ice was as white as a bale of cotton and the red streak was as prominent as ever. On examining the system I could not discover any chance for air or raw water to enter. All the bolts that held the return bends in place were tight, and the automatic valve held a pressure on the coils.

Taking out a plug and putting a pressure of water on the coils I discovered cooling water leaking through and ascertained that the return bends were not set up hard enough to expand the rubber gaskets against the inner pipe; this allowed the cooling water to leak through and mix with the distilled water whenever the regulating valve opened. After making the return bends tight, the ice was as clear as a pane of glass and the red streak entirely disappeared.

It was customary for some of the office force to watch the side track and when a meat car was run in, go out and sweep up the salt and add same to the brine in the tank. In consequence, the brine was very dirty and the circulation sluggish. In looking for the cause of the poor circulation I found pieces of meat, sticks and waste wedged in the coils where the partition was cut away and where the brine crossed from one side of the tank to the other. After removing the "hash" the circulation was improved.

In another plant the reboiler was in a very exposed position and whenever the wind blew from an easterly direction the water would cease to boil; consequently there was a great deal of air-shot ice pulled. The trouble was removed by building a shed over and around the reboiler.—Power.

GRAPHITE AS A LUBRICANT.

By Orrin E. Dunlap.

The increasing esteem in which graphite is held as a lubricant is well portrayed by a recommendation made in the report of the National Fire Protection Association committee on artificial refrigeration, section 6 of which says:

"It is recommended that wherever in any system graphite can be used as a lubricant in compression cylinders, that it be done. This especially applies to air compressors used in dense air systems and for air compression for purposes other than refrigeration, as the temperature of the compression cylinders undoubtedly rises in some air systems to a point where inflammable vapors may be generated from lubricating oil."

This recommendation is particularly important because it denotes that sentiment is rapidly in creasing in favor of the use of graphite as a lubricant in every field to which it can be applied, and because of the very marked advancement that has been made in developing graphite lubricants by scientific methods, there is no field in which graphite is not available in ideal form for rendering a perfect service as a lubricant. We must give credit for this scientific advancement, this modernizing of our lubricating facilities, to Dr. Edward G. Acheson, President of the International Acheson Graphite Co., also of the Acheson Oildag Co., of Niagara Falls, New York. To review Dr. Acheson's accomplishments in making graphite available in its best forms for the purposes of lubrication, is like glancing behind the curtain supposed to conceal a realm of impossibilities, for he has given the world a graphite which remains suspended in either water or oil.

However, before we consider the merits of these new lubricants let us study the process man has developed for making graphite of higher purity content than that made by nature. We study Dr. Acheson's life and we find that in 1890 he discovered a process for making Carborundum, which to-day is stated to be the hardest known abrasive. No man had blazed the path along which his research was being conducted. He was the pioneer in the field where crude raw materials are taken and made to give forth the qualities essential to the development of new materials. The electric furnace of the Acheson type is operated at a very high temperature, and after he had made Carborundum and so continued his experiments he discovered a process for making a very fine, soft unctuous graphite, the purity of which is guaranteed to be at least 99 p.c. This was in 1906.

Having discovered the process for making a practically pure graphite, Dr. Acheson next devoted his attention to find a way whereby this graphite could be utilized as a lubricant. It is well known that powdered graphite is very difficult to handle or to apply to many parts that require lubrication. This knowledge led him to further research, the result of which was that he found a way whereby graphite is deflocculated.

Deflocculated graphite is graphite reduced to practically the molecular condition, and is believed to be the finest state of sub-division. Graphite in this form will remain suspended in water, in which form it is called Aquadag. This same graphite suspended in oil is called Oildag. Both of these new lubricants are now available in paste form and are patented and trade marked throughout the world. The pure, soft, unctuous graphite in the form of an impalpable powder is available for use mixed with a high-grade grease, and this makes possible another method of lubrication. Thus, for our new lubricants we have Aquadag, Oildag, Graphited Greases and Dry Powdered Graphite. The value of these lubricants is intensified by knowledge of the fact that they are without the impurities always found associated in natural graphites, indicating that they will not carry into bearings or in oiling systems such impurities.

In the power house and industrial field, unctuous, pure graphite must be considered as the only true lubricant available for use and the leading question of to-day, "What Constitutes a good lubricant?" is easily answered by saying Unctuous, Pure Graphite. Oils being fluids, quickly run out of bearings, while plain ordinary greade melts and runs away with equal rapidity. This waste denotes that such lubricants are actually thrown away. With the grease or the oil lubricant absent, the metal parts quickly seize and cut, causing very pronounced wear and dangerous hot bearings. It is not so when graphite is used as a lubricant. The value of graphite as a lubricant is found in the fact that in the forms specified above it is mixed with oil or grease to act as a carrier, but the unctuous, fine, pure graphite clings to the metal surfaces. As it is used day after day it quickly fills in the hollows and buries the irregularities of the surfaces, imparting a veneer that does not split or cut, and furthermore the graphite between the bearings will move within itself like a film of oil, affording perfect lubrication, which is utterly impossible where grease or oil is used alone. Flake graphite that is crystalline and hard does not so readily adapt itself to the needs of lubrication. Particularly so as it is natural graphite and contains a greater percentage of impurities which should be kept out of all lubricating systems and bearings if best results are desired.

Engineers and others in the power field cannot too soon begin a very active study of the merits of graphite as a lubricant. It may be, it probably is, a fact that many engineers have little appreciation of natural graphite as a lubricant, having found it to contain injurious impurities. But despite their experiences in the past, if they desire to operate the plants under their control at the highest efficiency, they should come to know the remarkable qualities possessed by graphite which is a product of the electric furnace. They should know that brightness or blackness in graphite is no indication of quality or relative purity. Brightness in a graphite is evidence of ability to reflect light, and to do this requires a particle of some measureable size and of a compact homogeneous nature. Flake graphite has a lustre, while unctuous, pure, soft graphite, the kind that is at least 99 p.c. pure and a perfect lubricant in itself, the kind which possesses great spreading, covering and polishing power, has no lustre owing to its fineness of subdivision, it being an impalpable powder. Beyond question, the graphite thus described is the purest and best in the world.

Prof. Charles F. Mabery, of the Case School of Applied Science, is recognized as an expert authority on oils and their qualities of lubrication. Only recently Prof. Mabery had reason to study the merits of graphite and his conclusions as to its value as a lubricant are well portrayed in a report he has made in which he says:

"The importance of the general use of graphite in lubrication in the world-wide saving of power cannot be estimated, also its possible prolongation of the natural supply of petroleum, while from what I have seen of your processes, deflocculated graphite can be manufactured as long as carbon in any form is obtainable, leading me to consider graphite the future lubricant of the world."

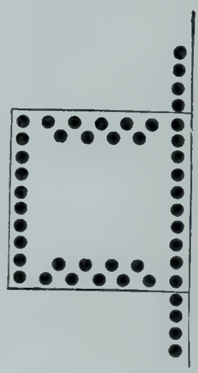
May I tell your readers also that a Special Graphite Committee and the Technical Committee of the Automobile Club of America recently tested the merits of graphite lubricants and their appreciation is well portrayed in their statement that graphite, in the forms in which they tested it:

1. Increases the efficiency of the engine.
2. Decreases the smoke from the exhaust.
3. Decreases the quantity of lubricating oil.
4. Retains compression in cylinders.
5. Causes the engine and gears to run more sweetly.
6. Decreases the liability of burning out bearings.
7. Increases the life of all bearings.

BOILER PATCHES.

The Fidelity and Casualty Co., New York, state that if for any reason, it becomes necessary to put a patch on a boiler, the patch should be put on the inside, not on the outside. By putting it on the inside, a pocket in which scale or grease may accumulate is avoided. The patch may be gotten inside the boiler ordinarily if made of an oblong shape, its short width being less than the long diameter of the man-hole.

In putting on patches, it should be borne in mind that in cylindrical shells the longitudinal stress per unit of section, and the patch should be designed accordingly. Thus a patch with longitudinal edges having an average inclination of 45 degrees to the circular seams, even though single-riveted, may be equally strong as a patch with its longitudinal edges perpendicular to the circular seams, even though the longitudinal edges are double riveted. The patch shown in Fig. 2 is equally strong as the patch shown in Fig. 1, provided rivets of the proper diameter, properly spaced, are used.



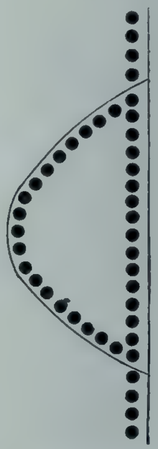


Fig. 1.—Square Patch. Fig. 2.—Diagonal Patch.

COMMUTATOR LUBRICATION

The lubricants best suited for use on commutators, and the extent to which they should be applied, have been vexed questions in the past. It is now generally admitted that as little as possible lubricant of any description should be used, says the Mechanical World. The electrical desiderata of commutation are best attained by the maintenance of clean brushes and commutator surface free of any oil or grease. In some cases, however, a certain amount of lubrication becomes essential, either on account of screeching of the brushes or on account of serious heating due to an abnormally high peripheral speed of the commutator. In the latter case lubricant can only effect a partial remedy.

Lubrication of Metal Brushes.

Assuming the use of simple gauze or laminated copper brushes, it is usually sufficient to wipe the commutator from time to time with a rag lightly soaked in paraffin. The use of vaseline jelly or similar lubricants should never be permitted. In some cases vaseline is applied so often and so thickly to commutators as utterly to defeat its initial object. It becomes carbonized, and is liable to cause flashing over from segment to segment. It clogs the brushes and prevents that free movement by which they usually allow for slight commutator irregularities. The heel of the brush becomes thoroughly choked with caked vaseline and the dust and dirt which it so readily collects. There is then no remedy but to remove the brushes, clean them by steeping in benzine, and rigorously to avoid such lubrication in future. The use of any heavy lubricating oil is equally injurious. Where a somewhat heavier lubricant than paraffin is deemed advisable, a good mixture is: Paraffin oil, 5 parts; olive oil, 3 parts; ammonia, 2 parts (by volume) —but this should be applied very sparingly.

Gauze brushes are occasionally loaded with graphite; this doubtless acts as a lubricant, but is liable to cause dust, which is objectionable as so easily lodging between commutator bars and leading to breakdowns.

By the use of compound brushes built up of alternate layers of copper and anti-friction metal, the brush friction losses are somewhat reduced, and some advantage occasionally accrues from the high cross-resistance of such brushes.

Lubrication of Carbon Brushes.

No vaseline or any kind of oil should be applied to a commutator fitted with carbon brushes. Hard carbon brushes give less trouble than other types, as regards both wear and maintaining a clean commutator; the harder material should therefore be used, unless electrical considerations require the contrary. Hard brushes are, however, liable to be somewhat gritty, and to make a grinding or even a screeching noise in service. To overcome this the brushes may be heated to a dull red and plunged into thin machine oil, and, when cool, drained for use; or the brushes may be boiled in refined paraffin wax for an hour or so and allowed to drain in a warm place. Both these methods are good, and secure the slight degree of lubrication required to ensure "sweet" running without smearing the commutator or causing a collection of dirt and clogging.

The use of composite brushes made up of graphite and copper dust hydraulically pressed into blocks is not to be recommended. The material has not such a low co-efficient of friction as plain copper brushes, and the peculiar contact resistance of carbon which forms its chief merit as a brush material is largely sacrificed by the admixture of copper. Such brasses are liable to cause much dust as they wear, and this being largely metallic, is very dangerous.

Commutators should be cleaned with fine glass or sand paper (never emery) held on with a wooden block cupped to the commutator radius. Burnishing should then be effected by a pine block similarly shaped, and the commutator finally rubbed with a paraffiny linen rag. A periodical cleaning on these lines, coupled with obedience to the above lubricating rules, will ensure a long and satisfactory commutator life, providing the electrical conditions (reactance volts, etc.) permit of sparkless commutation. If they do not, it will be impossible ever to maintain the commutator bars in good condition for more than the briefest periods.

VALUE OF FLUE GAS ANALYSIS.

In a recent boiler plant test made by the coal department of The Arthur D. Little Laboratory, Boston, the loss due to unburned gases from a thick, uneven fire was illustrated by an interesting occurrence in connection with the flue gas analysis. The test showed the following relative conditions :—

	1	2
Sample of gas taken—	5 p.m.	5.30 p.m
Carbon dioxide CO2 p.c.	11.3	14.3
Oxygen, O2 p.c.	6.5	4.5
Carbon monoxide CO p.c.	2.4	0.0
Nitrogen, N2 p.c.	79.8	80.2
Air excess p.c.	45.	36
Temperature flue gas, F.	545	700
Heat lost due to CO p.c.	9.7	
Heat lost due to increased temp. of flue gas p.c.		4.3

The first analysis shows a considerable amount of CO to be present. Before taking the next sample the CO started to burn through the passes of a 600 h.p. Aultman & Taylor boiler and the CO was being entirely consumed. The flue temperature rose 155 degrees on account of the burning of the CO through the passes of the boiler instead of in the furnace. There was no combustion chamber and the fire was so thick that it came close to the bottom row of tubes.

A number of points can be drawn from this instance.

(1) Had the boiler been set with an ample combustion chamber all gases would have been burned before coming in contact with the heating surface, resulting in a gas analysis like No. 2, but with a temperature corresponding to No. 1.

(2). The fire should not be carried so thick that CO will be formed, as it is very difficult to burn it all in a boiler furnace when once formed and the loss due to small percentages of CO is very great.

(3). The determination of CO2 alone is not sufficient to determine whether the boiler is being properly fired. In the case of No. 1 sample a CO2 indicator should have shown 11.3 p.c. CO2, which would ordinarily have been considered very good, but there would have been no indication that CO was present, while the loss due to it was as great as if the CO2 had been only 7.5 p.c. with no CO.

EFFECT OF SOOT ON BOILER TUBES.

The quantity of air admitted to a boiler furnace is a matter having far-reaching effects. With hand firing, frequent opening of doors is absolutely necessary. Advocates of this method say that in this way air is supplied to the top of the coal, and, uniting with the gases rising from the coking fuel causes complete combustion. When the air thus admitted is cold it reduces the temperature of the gases and of the heating surfaces, and in thus retarding combustion increases the deposit of soot. Every engineer and fireman knows that soot is a poor conductor of heat, but to what extent soot prevents heat transmission is not as definitely known.

Some boiler trials were recently conducted to determine this loss. During the first series of tests soot was allowed to remain on the tubes. The evaporation from and at 212 degrees per pound of dry fuel was 6.2 pounds. The dry coal per square foot of grate surface was 13.4 pounds, and the temperature of escaping gases 627 degrees F. Before the second series of tests was made the tubes were carefully cleaned, with the result that the evaporation from and at 212 degrees per pound of dry coal increased to 7.04 pounds of water, a gain of 13½ per cent. The saving is still further evident from the fact that the amount of dry coal consumed per square foot of grate per hour was reduced from 13.4 to 9.09 pounds, and the escaping gases to a temperature of only 546 degrees.

Evidently for best economy cold air must not be allowed to cause the deposit of soot. Probably the easiest way to prevent this is the use of a mechanical stoker, preferably the Taylor Underfeed type, which maintains an incandescent fuel bed, the coal being fed beneath the hot coke. Both fan and stoker are driven by the same engine so that the air supply is automatically adjusted to the rate of feeding fuel. The advantage of thus controlling the volume of air is that the air is not only of the proper quantity, but when it has passed through the incandescent coal it is of the high temperature necessary to complete the combustion of the gases, and at the same time maintain the high temperature of the heating surfaces.

Correspondence

Discussion on Previous Articles
Remuneration for Useful Ideas

DRY KILN.

In subscriber's letter on "Dry Kilns" on page 48, January issue, the writer does not say whether live or exhaust steam is used, how far steam has to travel to get to kiln nor what kind of heating system is used, whether vaccuum or what the conditions in general are.

A lumber dry kiln has to have good circulation and does'nt want to have pipes all over the bottom. Leave a strip at one end without pipes, and have ventilators above that part, and an opening near bottom below steam pipes at the other end, so as to make a circulation.

Evidently the heat is not intense enough to make the lumber sweat, and I have turned the hose on lumber when ready to go into kilns, which will cause it to sweat and then it will dry out and have no bone in the centre. To have a high temperature in a lumber dry kiln is not the only essential, as circulation (of which I spoke before) is necessary, also if exhaust is used see that you are getting sufficient to raise the required temperature.

I had charge of a dry kiln some years and the exhaust steam all went into the kiln during the summer months when load was heaviest and lumber dried fine, and quickly too. In the winter when the load was light, half of the steam (exhaust) went to a blast coil for shop heating, and the other half to dry kiln, result low temperature and slow and poor drying in kiln, but I could do nothing else as I had to do the best I could with what I had.

JOHN THURLOW.

ELECTRICAL INFORMATION.

We would like to have the opinion of your readers concerning an electric plant. The answer might prove useful to many of your readers who, like me, perhaps, lack a technical education.

1. We have a dynamo of 115 k.w. 3 phase, 60 cycle. Our three wire are of No. 6, and the power house is two miles from town. Is that wire big enough to supply 2,500 16 c.p. lamps ?

2. Is it necessary to have all primary No. 6 wires from the main street to a distance of ¼ of a mile each way. Will No. 8 wire do for secondary ? Our transformers are of five and ten k.w.

3. Is No. 14 wire big enough for house wiring, from ten to fifteen 16 c.p. lamps each house ?

4. I would like to know the lighting rate of different small towns, either flat rate or meter rate, also what system is more in use, meter rate or flat rate for a plant with about 125 customers and about 2,000 lamps. Would it pay to give day service ? All suggestions and information on these subjects will be well appreciated by yours respectufully,

IGNOTUS.

ELECTRICAL PROBLEMS ANSWERED.

In answer to some queries by Greenhorn in the January issue, I trust the following explanation will help him.

1. The power factor of induction motors is governed by the magnetic leakage, and inductance. To have a high power factor, the magnetic leakage and consequent inductance must be kept low. This is done by using a small air gap, subdivided windings and slots, which are partly open at the top. The power factor of a motor at full load will depend somewhat upon its size. 10 to 20 h.p. should have a full load power factor of about .85.

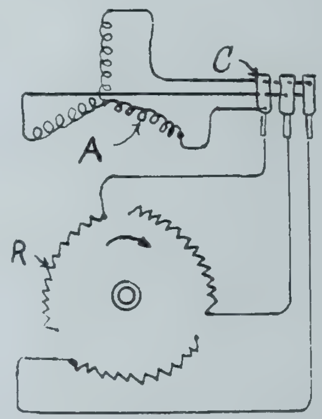


Fig. 1.—Diagram of Connections, A is Armature Winding ; C, Collector Rings ; and R, Resistance.

2. The peak load is the heaviest load a station is called upon to deliver, but this does not mean to say that a station outfit is designed to carry it continuously. Take a dark day, when a central station has a fair load on, and suddenly customers commence to switch on their lights; there is a sudden demand for current, which is met by switching in, more machines. According to the recording meters this kind of load is what is known as the peak load, because it is the heaviest, but as a rule does not last long.

3. Synchronous means two or more events to act together, or in step instantly. In the case of a motor, synchronous motors are so-called because they run in synchronism, or in step with the alternator, supplying the energy to drive them. The construction is almost the same as that of alternators, and the fields must be excited with direct current, the same as alternators. Single phase synchronous motors are not self starting, and are but little used, polyphase synchronous motors start with about 25 per cent. of full torque, but require a very large starting current. Because of their low starting torque and excessive starting current, they are only used in the larger sizes, and where frequent starting with a load is unnecessary.

4. Polyphase induction motors are self-starting and have considerable torque. They consist of two main parts, namely, the primary, or field, to which the line is connected, and the secondary, or armature, in which currents are induced by the action of the primary. Either of these parts may be the revolving member, but, as a rule, the field is stationary, and the armature revolves, giving rise to the names, stator and rotor, respectively.

The induction motor, generally speaking, is not so well adapted for variable speed as the direct current motor, although its speed can be varied through a great range. To accomplish this result, the rotor is provided with a three-phase Y, connected winding and connecting a variable resistance in series with each phase, as in the accompanying illustration. The three terminals of the winding are connected to collector rings mounted on the shaft, and the current flows through the resistance, by way of the collector rings. By means of a three-pronged arm, the resistance in series with each phase of the rotor winding can be varied from full current to zero, thus varying the speed from minimum to full speed.

5. The steam consumption of steam pumps per horse power per hour may be anywhere from 50 to 120 pounds of steam, according to size, condition and use of pump. Steam pumps, and especially boiler feed pumps, are wasteful of steam, as they take steam practically the full stroke, and do not run at a constant speed. For a duplex boiler feed pump, the steam consumption can be found approximately by finding the amount of water in pounds displaced per stroke×boiler pressure×2.31, which will equal foot pounds of work per stroke for each cylinder; or, expressed as a formula, number of strokes per h.p.= water in

$$\frac{\text{lbs. per stroke} \times \text{boiler press} \times 2.31}{33{,}000}.$$

Boiler pressure×2.31 = head against which pump has to force the water, and a column of water 2.31 ft. high equals a pressure of one pound. When the number of strokes are found, the steam consumption is obtained by the following formula, $S = L \times A \times N \times W$, where S = steam consumption; L=length of stroke in feet; A=area of piston in square feet; N=number of strokes, and W=weight of a cubic foot of steam at boiler pressure. This formula is for h.p. per minute.

6. In the case of a synchronous motor, the speed is fixed by the frequency of the supply current. If s=speed of a synchronous motor in revolutions per second; p=the number of poles, and u= the frequency of the supply current. $s = (2 \times n) \div p$, and the revolutions per minute = $(120 \times n) \div p$. In the case of induction motors, where there is practically no load, the motor runs very nearly in synchronism, but the speed drops off as the load is increased. This difference in speed between that of the rotor and of the field for any given load, is called the slip. If s, represents the speed of the rotor, and s, the synchronous speed, or speed of the revolving field in revolutions per second their slip (rev. per sec.)$= s - s_1$, or expressed as a percentage of synchronous speed slip (%)$= \dfrac{(s - s_1) \times 100}{s}$.

Synchronous speed is determined the same as for synchronous motors, where u=frequency, and p=poles, thus $s = \dfrac{2n}{p}$.

JOHN C. TWEEDALE.

LIGHTING PROBLEM.

Answering T. P. Leslie's enquiry in Sept. issue, page 42, I would say that a standard 16-candle power lamp at 110 volts, takes .51 amperes, or 56 watts. 2½ kilowatts at 110 volts $= \dfrac{1000 \times 2.5}{100} = 22.7$ amperes. This will light $\dfrac{22.7}{.51} = 44$. 16 c.p. lamps with safety. A kilowatt= 1,000 watts. To produce a kilowatt, you must have voltage and amperage, because kilowatts $= \dfrac{\text{volts} \times \text{amperes}}{1000}$, and watts=volts and amperes. From this it is seen that the voltage and current has to be taken into consideration, since you cannot get a candle power without voltage, neither can you get it without current.

J. C. TWEEDALE.

BOILER FEED-WATER PROBLEMS.

In the January number there is an interesting letter by John Thurlow, on the above mentioned subject. Its chief interest lies in the fact, that by the use of a mechanical boiler, he was able to run a boiler for fourteen weeks with the water clean at the end of the run. He also says that scum was stopped from being carried over to the engine with the steam. Well, of course, if the water is clean, there will be no scum, and the gauge glass will be clear, and the water column connections will be clean.

I once asked a boiler inspector about the condition of certain boilers, which I knew were equipped with mechanical cleaners.

His reply was that they were no better than they were before the instalation of the cleaners, which would indicate that the boilers were very clean before the cleaners were installed (in which case they were not needed) or the cleaners were no good.

I have an impression that boiler inspectors, as a rule, are opposed to mechanical cleaners, and that impression has been acquired by talking to them about cleaners.

In a water purification plant the water is treated with chemicals in a tank, and the precipitates removed by filtration. The pure water is then fed to the boiler.

If, as is usually the case, the water is fed to the boiler without being purified the heat precipitates the scale-forming materials. If it is not blown out along with a quantity of water at blowing-down time, it attaches itself to the boiler plates and tubes.

But suppose we place a skimmer in the boiler, and conduct the water to a vessel outside the boiler in which the scale-forming material will have a chance to settle, and the clean return to the boiler, we will have a water purification plant in which heat instead of chemicals is the precipating agent.

The thing looks reasonable to me, and I intend to try it.

Would it not be a good thing also if those who have tried it would speak up as Mr. Thurlow does, and tell us their experience.

A clean boiler is a safe boiler compared with a dirty one.

It is admitted by the best authorities that no amount of heat will injure a boiler plate if it is clean and there is plenty of water on the other side of it.

A clean boiler is an economical one compared with a dirty one. Scale 1-16" thick is estimated to waste 12 to 16 p.c. of the fuel burned. Thus if a boiler uses 3 tons of coal per day for 300 days, at $3 per ton the value of the fuel wasted, taking the rate as 14 p.c. would be $\dfrac{14}{100} \times 3 \times 300 \times 3 = \$378$. Some authorities claim that scale causes a loss of $750 per year for every boiler in the United States.

R. McLAREN.

FISHER FUEL ECONOMIZER.

Tests are being carried on by the Fisher Fuel Economizer Co. with their economizer on the railroads and in several power plants, where the smoke nuisance has been a cause of complaint. At the Berg Machinery Co., Toronto, a test was made recently, which shows that the smoke was greatly reduced. Without treatment of coal, there was still a dense smoke at four minutes after firing, while with the treatment there was only a slight smoke at one minute after firing. The economizer is being placed on the market by the Fisher Fuel Economizer Co., 74 Bay St., Toronto.

DURO HIGH PRESSURE PACKING.

The Economical Mfg. & Supply Co., 269 Queen St. E., Toronto, have prepared samples of their Duro High Pressure Piston and Valve Rod Packing, in a neat box for mailing to those interested. This packing is constructed to hold high pressures for marine and stationary engines, air compressors and pumps.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. III FEBRUARY, 1910 No. 2

DAILY PRESS AND ENGINEERS.

In the Jan. 31 issue, the Toronto Telegram reprints an article from Railway and Locomotive Engineering, "Why Boilers Blow Up." This is the same article reprinted in the October issue of The Power House under the heading, "The Cold Water Delusion." To this we added the following comments:

"If the water gets so low as to be out of sight in the glass, we would advise covering the fire with ashes or coal and allowing the boiler to cool at once. We think it is the safest plan."

That it is the safest plan, was shown by comments in succeeding issues of The Power House. In one case where water was fed into a red hot boiler, the plates cracked, so that serious consequences would have resulted, had the steam pressure been raised on the boiler.

Engineers should read their technical papers. If they do there will be less liklihood of explosions to make "good stories" for the daily press.

We would advise engineers to be very careful with the boiler in their charge. They are not toys and only disastrous results will follow "experimenting" with them.

The Toronto Star of Feb. 1, tells of the engineers' representation made to Hon. J. S. Duff, under the heading of "Engineers Want to be a Close Corporation." It would be a greater safeguard to high life and property if the engineers were a "close corporation." They have the safety of people under their care the same as a doctor, and if human life and property are to be safeguarded as they should be, then it is better for all concerned, that engineers be a "close corporation." We would then have a less number of tales of boiler explosions to relate.

In British Columbia there have been practically no explosions during the continuance of the "Act respecting the Inspection of Steam Boilers and Engines, and the Examination and Lincensing of Engineers in charge of Steam Boilers and Engines."

The requests of the Ontario engineers are practically that a portion of British Columbia's Act be added, so that Ontario's Act be more workable and more strict. This will mean the operators must receive a more thorough education in their business thus adding to the safeguard of life and property. If this is to be accomplished by making them into a government controlled "close corporation," the quicker the suggestions to make the regulations more strict, the better for the engineer, his employer and the public generally.

◆

SMOKE ABATEMENT TOUCHES THE POCKET.

In the January issue of The Power House we published a number of by-laws relating to the prevention and abatement of smoke. These gave an idea of the smoke nuisance as seen from the various council chambers and by the public generally.

There is, however, another viewpoint, that of the engineer, and the part that affects him from the standpoint of complying with the regulations is as follows:

> No owner, lessee, tenant, agent, manager or occupant of any premises or steam engine in which a fire is burned and no person who operates, uses or causes or permits to be used, any furnace or fire within the limits of the City of Hamilton, shall permit the emission to the atmosphere from such fire, of opaque or dense smoke for a period of more than six minutes in any one hour. The point at which such emission shall be determined shall be at that point at which the smoke is discharged from the opening, flue, stack or chimney to the atmosphere.

If an engineer has one boiler discharging smoke into a stack, he can with little difficulty, comply with the by-law, but if there are three or four or five boilers, the furnaces of which are all connected to one chimney, what then? For one boiler the by-law is very reasonable, for three or four or five boilers, etc., it is very unreasonable. If there are six furnaces, handfired, there is really a continuous firing. If therefore six minutes is allowed for one, then at this rate thirty-six minutes should be allowed for six when only one chimney is being used for six. Of course, thirty-six minutes would not be required, but, certainly, the number of furnaces should be taken into consideration in the framing of a by-law.

The legislation is in the right direction if the number of fires and the condition of the atmosphere are taken into consideration. Tests have been made with two boilers, using every care in firing and while compliance of the law is possible under ordinary atmospheric conditions, it was impossible on the day the test was made. It was unfair of the enforcers of the law to use the charts taken on such a day and use it to take the engineer of the two boilers to account.

The writer timed several chimneys in London and Toronto, the former city having no by-law and the latter city with a by-law to enforce the abatement of smoke. While in Toronto certain plants were not within the time limit, it was found that, although on some days in these plants, the smoke emission was from seven to fourteen minutes in the hour, it was due to atmospheric conditions or the number of boilers, not as a rule to lack of proper equipment. The attempt in one plant, to keep within the time limit resulted in a saving of twenty per cent. of fuel without any loss of efficiency though it often exceeded the six minute limit.

In London, however, there were some chimneys that emitted smoke from ten to forty minutes in an hour on the day the writer made the test. On other plants in the same city there was a very small emission of smoke, the reason being that proper boiler room equipment was installed and great care was taken in firing, so that the trouble in the former case was not due to atmospheric conditions.

In enforcing the smoke abatement laws, the number of fires and weather conditions should be taken into account. Manufacturers and engineers, however, should realize the great saving in fuel that may be effected by giving attention to firing and proper boiler room equipment, independent of the saving in fresh air, etc., caused by the non-pollution of the atmosphere with smoke.

To illustrate with a concrete example. If a manufacturer averages $4 per ton for fuel and uses 10 tons per day or 300 tons per month, under old conditions of firing, the cost will be $1,200 per month or $14,400 per for fuel. If a saving of even ten per cent. may be made year for fuel. If a saving of even ten p.c. may be made is what we quoted, and is the saving one manufacturer effected) the amount saved is $1,440.

Do you realize what it means. This amount is sufficient to pay the interest on $24,000. Possibly you never looked at it in that light before. If not, figure it out in the light of proper firing, and boiler room equipment and see whether it pays or not, to have an up-to-date boiler room.

We have realized it and in the January issue gave an article on, "What Canadians are Doing for the Abatement of Smoke." This is the beginning of a series of interesting educative articles on smoke abatement and its consequent savings. In this issue is an article on "How to Secure the Smokeless Combustion of Fuel." It is the second of the series and deals with draft, being prepared by W. Norris, M.E., of the London Street Railway. We shall have other articles on draft, grates, stokers, blowers, etc., the whole series being concluded by an article from a competent writer who is a prominent boiler inspector and whose experience along this line has been wide and varied.

ONTARIO ENGINEERS' REGULATIONS.

In our January issue we referred to a deputation making requests to the Ontario Stationary Engineers' Board. The deputation waited on Hon. J. S. Duff on Feb. 1, and asked that the additions referred to be made to the regulations.

As previously stated, they desired that all engines and plants having a capacity of 25 h.p. or over, and a steam pressure of ten pounds or over should come within the jurisdiction of the act. At present it only covers plants of 50 h.p. or over or a steam pressure of 20 pounds.

They also asked for a standard by which the h.p. should be figured, and suggested that a h.p. should mean 12 square feet heating surface for tubular boilers, and 10 square feet for water-tube boilers. This, however, they pointed out, was merely a suggestion, and they would be quite willing to accept any other reasonable definition so long as it constituted a standard basis for figuring.

Another request was that the Board of Stationary Engineers should be given power to enforce the act, and they likewise requested that henceforth two years' practical experience be one of the requisites for passing the examination.

They also asked for an addition to the act providing that it cover persons operating a hoisting plant in any building in course of construction or having charge of steam rollers or other construction apparatus in any town or city.

The objects of the amendments were to safeguard human life and property from the danger of boiler explosions and also to improve the standard of stationary engineering as a profession.

Mr. F. W. Barton, secretary, was chief spokesman for the engineers. The minister discussed the various points involved in a very friendly manner, and promised to give the suggestions detailed consideration.

HEATING A BUILDING FOR NOTHING.

At the meeting of the Central Railway and Engineering Club on November 5, 1909, Geo. M. Henderson, Toronto, read a paper on "Gas Engines, Their Origin and Commercial Use." During the discussion the subject of heating buildings was introduced, the following remarks being made by Mr. Bly, chief engineer at the Empire Building, Toronto:

> I find that by heating with exhaust steam I can heat the buildings for comparatively nothing when I am generating power.
>
> My men who are firing, have asked me to allow them, on Sundays, when the heating was heavy, to run the engines without generating any current or any power, because they could heat buildings easier by putting the steam through the engines than by heating straight from the boilers. That seems strange notwithstanding it is true. I find we do not have nearly so much water in the steam nor do we use so much of it when heating by exhaust steam, as the vibration of the engines seems to take the water out of the steam, consequently the men who do the firing invariably ask me to let them run the engines.

While Mr. Bly was criticized at the Railway Club for the statement published herewith, several prominent stationary engineers affirm that it is true.

One engineer, on being asked his opinion, asked if the same result could not be obtained by generating steam at a high pressure and throttle or dry it by passing it into the heating system through a pressure reducing valve.

Another engineer, on being consulted, suggested that probably the exhaust steam is at the point of condensation into water, and, in condensing, gives up heat units that it would not if fed into the system at a pressure of five or six pounds, enough to keep it dry.

There are therefore diverse opinions among engineers. In the light of Mr. Bly's above statement, let every engineer who has had experience in heating write us giving his opinion with explanations. We have our opinions, but more is learned by discussion than by making a statement and Mr. Bly's remarks are interesting, the whole question being worth investigation.

BOILER SCALE COSTS MONEY.

Manufacturers and engineers are beginning to realize that boiler scale costs money. Unless some measures are taken to keep water free from the scale forming constituents, the loss will be considerable.

As an example, take a boiler using 4 tons of coal per day at $4 per ton. That means $16 per day or $4,800 per year. If the boiler is badly scaled, say one-sixteenth of an inch, it means that 12 to 15 per cent. of the fuel is being wasted, that is there is a loss of at least twelve per cent. of the $4,800 or $400. This means that you are losing 6 per cent. interest on $6,666.67. You would soon pay for the necessary compound, heater or filter to eliminate the scale, and save money. Think it over. It is a paying proposition.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

PEEBLES ELECTRICAL MACHINERY.

Announcement is made on another page of this issue of the establishment in this country of the business of Bruce Peebles & Co., Edinburgh, Scotland, manufacturers of electrical apparatus, through their Canadian representatives, Vandeleur & Nichols, Dineen Bldg., Toronto. The firm of Bruce Peebles & Co., was established in 1866, but it was not until 1897 that the electrical department was added. The business, however, in their electrical specialties has grown so rapidly as to almost eclipse other departments and the works were gradually increased until they now occupy a site covering ten acres, the location being near Granton just outside of Edinburgh.

The accompanying illustration represents a two-pole rotor machine, with forced ventilation, and running at 3,000 r.p.m., three-phase, 50 cycle, 3,000 volts. These machines are manufactured in all sizes and for all voltages.

It is interesting to note that the Peeble's works are entirely self-contained, water is pumped from their own wells and the sewage treated in a septic tank in the grounds. Steam boiler house and gas producer plant provides the motive power for large generators, while a storage battery will operate all the lights and any department when the main plant is closed down. Vandeleur & Nichols form the last connecting link in a chain of branch houses and agencies which encircles the entire globe.

Peebles Steam Turbo Alternator.

RICHARDSON LUBRICATION SPECIALTIES.

Fig. 1 shows a new and neat design of adjustable sight feed fitting for use in connection with any gravity fed bearing lubrication system where it is desirable to see the oil flow at the points lubricated. These fittings are made for one, two, three or four pipe connections using "Union Cinch" type of joint (¼'' iron pipe size) ; or the pipe openings may be tapped for ¼'' pipe. The valve stem is tightly packed against pressure. The sight feed glasses are set up tight on shellaced cork washers. Base of fittings are threaded ⅜'' pipe size and regularly nickel plated and guaranteed to be of that uniform high quality characterizing Richardson specialties.

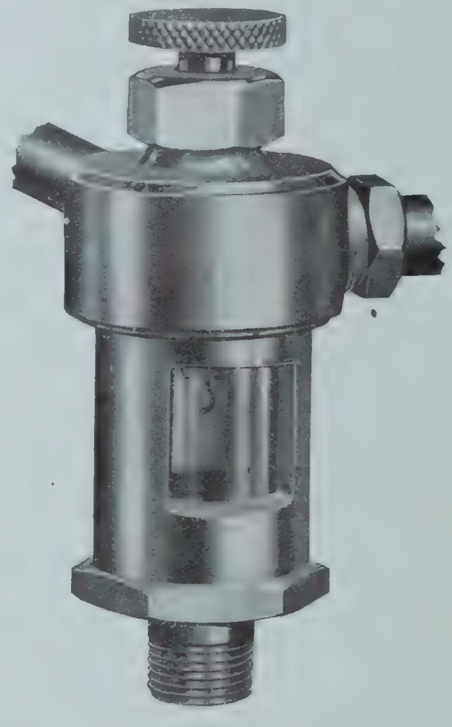


Fig. 1.—Adjustable Sight Feed Fitting.

Fig. 2 shows Richardson plunger pump. It has been designed to handle dirty oil that drains away from the engine bed and return it to the filter or take oil from a filter and send it up to an overhead storage reservoir. The diameter of plunger is one inch, and the length of stroke four inches.

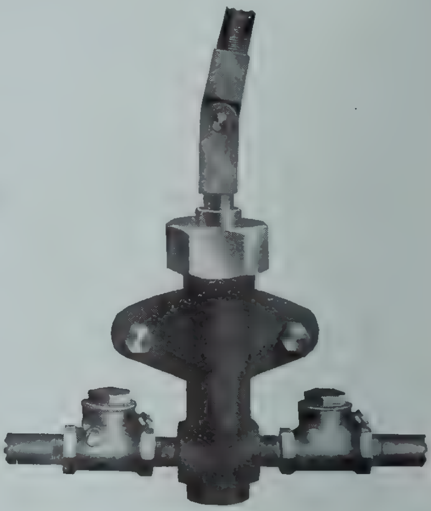
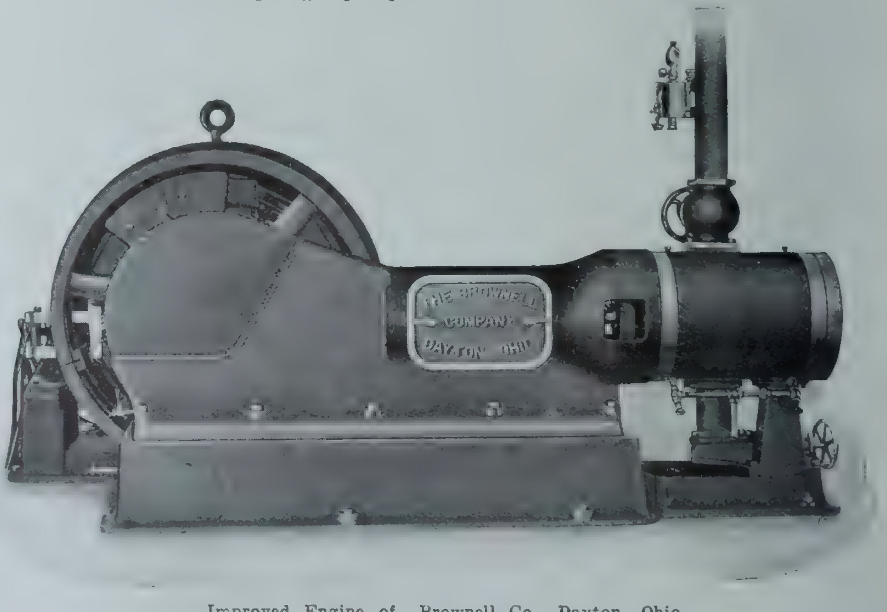


Fig. 2.—Richardson Plunger Pump.

These specialties are being placed on the market by the Sight Feed Oil Pump Co., Milwaukee, Wis.

BROWNELL SELF-OILING ENGINE.

The Brownell Company, of Dayton, Ohio, have recently made an improvement in their Twentieth Century high-speed side-crank steam engine, by enclosing it so that it runs in oil. The



Improved Engine of Brownell Co., Dayton, Ohio.

engine is already so well known to engineers that its general construction will not be described here and only the new feature will be explained.

The idea of self-lubrication in high-speed engine practice is now considered to be of the greatest importance in prolonging the life of the wearing parts. Friction is reduced to a minimum by the constant supply of oil, economy in oil is effected, cleanliness is easily maintained, and smooth and quiet operation through long periods is possible without depending upon the care and attention of the engineer in charge.

With the Brownell high-speed engine the system employed is simplicity itself. The oil is poured into the engine frame so that the periphery of the crank disc is in contact with the oil. As the engine is set in motion, and the crank revolves, oil is thrown by centrifugal force in great quantities back upon the guides and cross-head and into small reservoirs in the hood and engine frame, from whence it is carried to the main bearing, eccentric, and guide bar through short direct tubes. It is then taken back to the main reservoir in the frame by gravity and is used over and over again. The flow of oil to the main bearing, eccentric, and valve-head guides is lways visible to the operator, and the parts which are enclosed are always in a deluge of oil.

One of the attractive features used in connection with this system of lubrication is the hood which covers the crank-disc. It is constructed of the best steel furnished with handles, and angles, which are riveted to the sides and end where connection is made with the engine frame. Special attention is given to the fitting of these angles so that there is no leak of oil from the hood to the outside of the frame. Being constructed of light material, it is easy to remove and replace when inspection is desired, at the same time adding a neat finish to the engine.

FEED-WATER HEATERS AND RECEIVERS.

Among the most essential parts of an exhaust steam heating system are the oil separator to remove cylinder oil from the exhaust steam before the latter passes to the heating system, and a receiver or return tank to which the condensate can be brought back before being pumped into the boiler. This tank usually takes the form of an open feed water heater, and part of the exhaust steam is used for reheating the returns to 210 deg. F., or thereabouts, before they are pumped into the boiler.

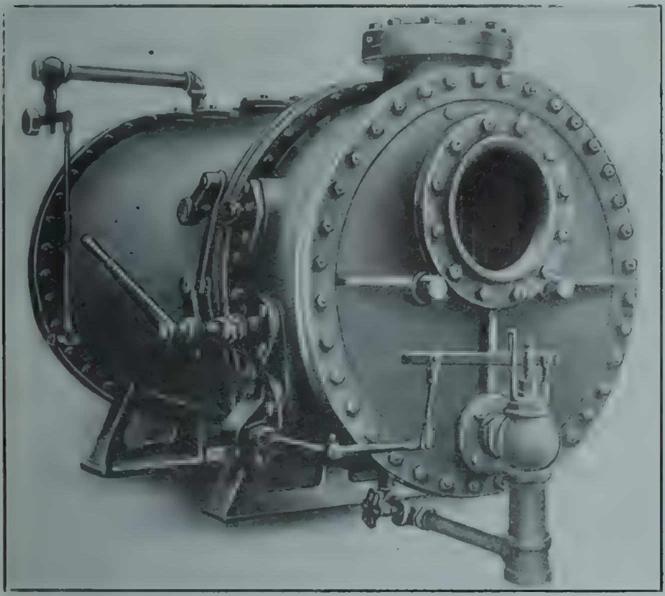


Fig. 1.—Harrison Cylindrical Form Separator.

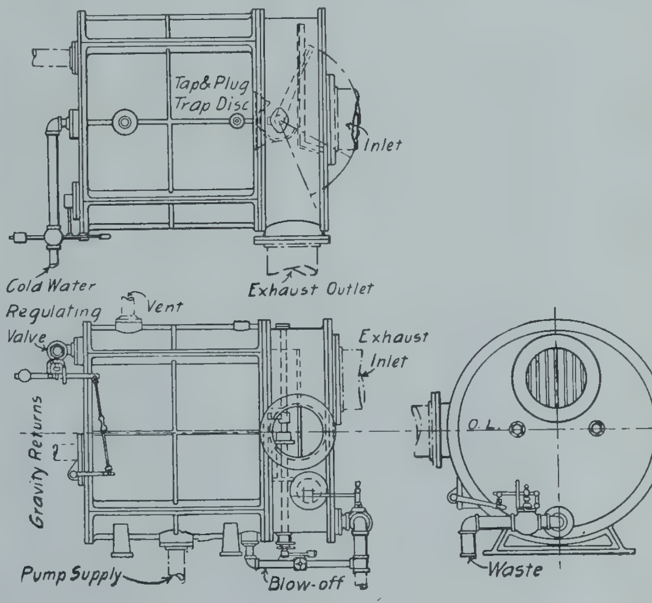


Fig. 2.—Harrison Heater and Receiver.

Recently the Harrison Safety Boiler Works, 3137 N. 17th St., Philadelphia, Pa., have brought out an improved type of heater and receiver, combined with an extra large separator and fitted with valves so that the separator can remain in service while the heater itself is cut out of circuit for inspection or cleaning. This combined apparatus saves a large amount of space in boiler rooms, which is important in large office and other buildings. Frequently, however, there is not headroom enough for the upright rectangular type of heater and receiver, in which case the horizontal, cylindrical form, fitted with the surplus exhaust or steam stack type of separator, shown in Fig. 1 is used.

The apparatus shown in the illustration is peculiar in that the steam stack is not at the top of the separator, as is ordinarily the case, but from the side, still further reducing the amount of headroom required. The separator covers the whole end of the heater, or rather the separator and the drainage trap, which disposes of the drips from the separator and of the overflow from the heater are both contained within the ring casting at the end of the heater, the shell of the heater being constructed something like that of a cylindrical surface condenser. A circular plate closes the end of the heater body proper and contains the port through which the steam enters the heater and the opening through which the waste from the heater overflow or skimming weir escapes into the trap. The separator ring is bolted fast against the plate. At one side of the separator casting is the surplus exhaust outlet, and below is the stuffing box for the lever to which is attached the float that operates the valve draining the trap.

Two semi-cylindrical valves on a common spindle serve to close the steam opening and the overflow opening simultaneously, and thus to shut the separator off from the body of the heater when the latter is to be opened for cleaning or inspection while the heating system remains in operation. At the top of the spindle is a handle swinging horizontally over the top of the heater shell. The separator baffle plate, which serves to arrest the particles of oil and moisture carried by the current of exhaust steam entering the separator is attached to the front cover plate of the separator, the steam passing around one side and then behind the baffle. When the steam valve is open, the steam is deflected into the heater, that is, the heater receives "preference," the remainder of the exhaust steam passing to the surplus exhaust outlet.

At the opposite end of the heater shell are the cold water inlet and the float mechanism controlling the same according to the level of the water in the heater. The opening for gravity returns is also at this end, as is the door for removing the trays over which the water is sprayed in the top of the heater, and the door for removing precipitated impurities and filtering material from the bottom part of the settling chamber.

The heater and receiver shown in Fig. 2 differs from the heater described above in that the exhaust outlet is at the top of the separator ring, and the valves are arranged on horizontal spindles connected to a common valve gear and handle, and the float controlling the cold water inlet valve is attached to a spindle passing through the main heater shell instead of through the rear end plate.

However the principal feature of interest about this heater is the use to which it has been put. It is installed between a steam engine and an absorption refrigerating machine, purifying of oil the exhaust steam passing to the refrigerating machine and receiving the condensed returns from the latter and such make-up water as may be required, and heating the same up to 210 deg. F. for boiler feed. In order to be able to operate the ammonia generator at any desired pressure, the heater has been made with a solid shell to withstand a maximum back pressure of 40 pounds.

New Barometric Condenser of Waterous Engine Works

Helander Condenser, a New Type, Contains Several New Ideas in Barometric Condensers—A Complete Description of Condenser

The keen competition in all lines of business is compelling engineers to realize that economy in a large manufacturing concern is as important a factor to be considered as earning capacity. This fact has resulted in bringing forward the condenser as an economical and efficient agent for reducing operating costs, and in order to meet this increasing demand for condensers and condensing apparatus, the Waterous Engine Works, Brantford, Ont., has placed on the market the most efficient and economical condenser which has yet been designed.

The condenser is constructed throughout of cast iron, thus offering a far greater resistance to the corrosive action of the water than would one of a steel plate construction; also all machined parts are protected from the action of the steam or cooling water, so that there is no opportunity for deterioration from acid or erosive action of foul condensing water.

There are no bolts, rivets or other movable parts used in the interior construction of this condenser, and no movable parts to be adjusted with the variation in load. The bafflers are supported by a ring cast on the inside of the vessel, and therefore require no bolts, rivets or other supporting parts which might be affected by the corrosive action of the cooling water.

As the condenser vessel is erected, generally in places where it cannot be reached by a crane, it is usually designed and shipped in small enough sections to be easily handled by the erecting engineer.

This condenser is made in two styles; namely types "A" and "B." In type "A" condenser, which is more satisfactory for overhead exhaust lines, the condensed vessel is supported on the tail pipe which conducts the cooling water and exhaust steam to the hot well after condensation. This is a very strong feature in this type, as it does away with all support, structural or otherwise, thus reducing cost of instalation, and greatly adding to the general appearance of the system.

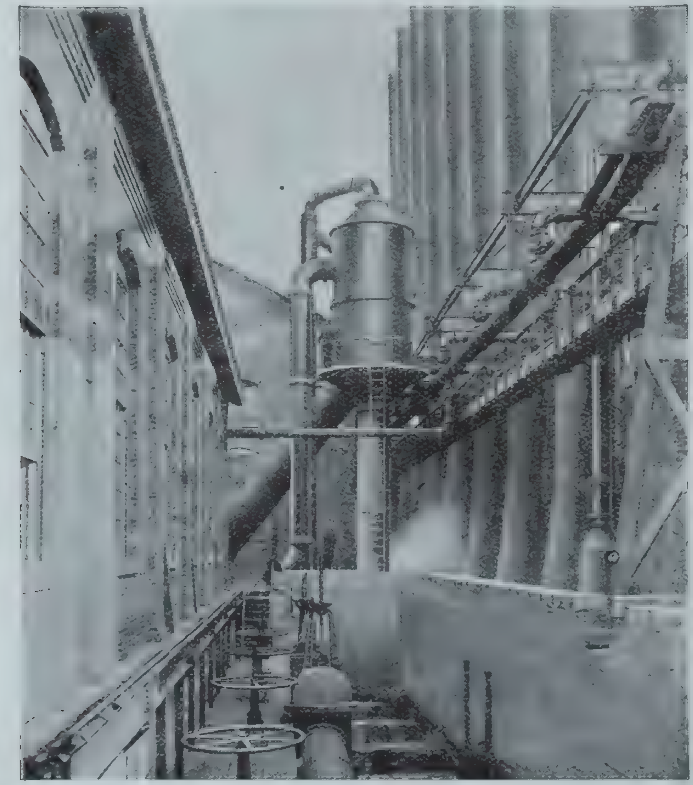


Fig. 1.—Instalation of Helander Condenser.

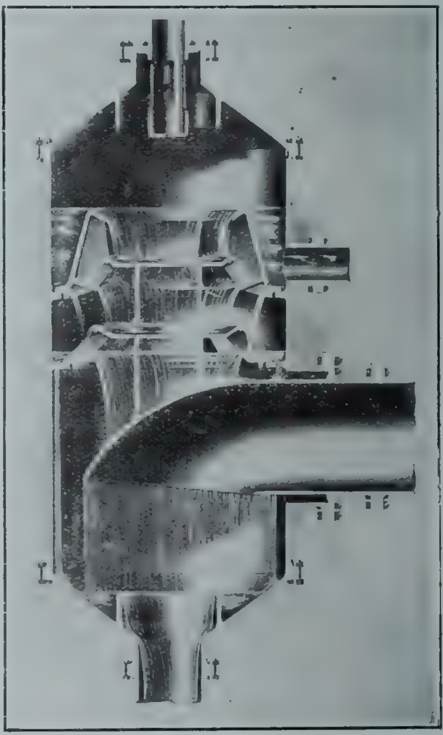


Fig. 2.—Helander Condenser of Waterous Engine Works.

It is readily demonstrated that valves,

elbows, etc., in the exhaust line greatly reduce the vacuum. This is of special importance in turbine work, where high vacuum is an absolute necessity for economical operation, and the type "B" condenser is especially built to meet these conditions. In the type "B" condenser, the exhaust steam enters through an elbow at the base and flows directly to the condenser through the supporting pipe. This admits of direct connection to the turbine or engine having underground exhaust; thus reducing the number of elbows and allowing almost a direct flow of steam from turbine to condenser.

The water and steam nozzles in type "A" and the water nozzle in type "B," may be turned at any angle desired to insure the most direct flow of steam. These nozzles are of ample size to insure them against becoming clogged, and there are no contracted openings to stop the free flow of water through the vessels and pipes.

Both types of condenser are made in six standard sizes, the larger size being capable of handling any amount of steam up to 250,000 pounds per hour, and special sizes are made where the quantity is greater than this.

Fig. 1 shows in connection a 114-inch condenser instalation at the plant. This condenser was designed to maintain a vacuum of 26 inches, when condensing 240,000 pounds of steam per hour with injection water at 70 degrees Fahrenheit.

With the large overload capacity and economical operation, the Helander patent barometric condenser is well suited to the central condenser plant arrangement, as well as to plants where the water supply is scant, or where the injection water is artificially cooled by means of a tower or pond; even in small plants, the well-known superiority of the barometric over the jet condenser has been recognized, and the higher efficiency and lower cost of maintenance easily overcome the difference in first cost.

Operation.

The cooling water enters through the nozzle near the top of vessel and rises until it overflows the top bafflers. It then falls on a second baffler, which deflects it to the side, where it is again deflected tward the centre and falls on to another baffler.

The water is again deflected to the sides and finally in the type "A" flows over the shield for the exhaust steam inlet. In type "B" the water falls into a pan and is carried off to one side and down the tail pipe.

The high efficiency of this condenser has been demonstrated by recent tests, during which the difference in temperature between the water in the tail pipe and the theoretical temperature of the steam at the vacuum pressure maintained was less than six degrees in cases where the load varies, and in cases where the load is steady, this difference is reduced to about two degrees; thus showing that there was a thorough mixing of steam and water, and that all latent heat was extracted from the former.

A very important factor to be considered in the design of a condenser is the non-condensing vapors, which form 2 per cent. to 5 per cent. of all the water passing through the vessel, and which must be removed if a high vacuum is to be maintained. In the Helander barometric condenser these vapors pass through the injection water, being cooled on the way through, and rise to the top of the vessel where they are removed by a dry air pump. At this point the density of the vapors is a maximum and the volume a minimum; thus permitting the use of a smaller dry air pump, resulting in small first cost, low maintenance and minimum power required.

It is customary in condenser practice to instal some kind of relief-valve, which is designed to open automatically, if at any tme the vacuum be lost and the pressure in the condenser rises above that of the atmosphere. There are valves of many designs for this purpose, but considerable trouble has been experienced in keeping these valves tight. At times when the pressure condition within and without the condenser are nearly balanced, the valve is apt to chatter, rapid wear results and the ability of the valve to seal the vacuum is lost. To overcome these difficultities a new type of relief-valve has been designed and patented, which in no way depends upon a mechanical tight joint to seal the vacuum when operating the condenser. This water seal is provided with all the condensers built by this company. It consists of a flanged opening in the tail pipe to which should be connected a free exhaust line. The flanged opening is provided at a certain distance above the opening for the water outlet at the bottom of the tail pipe, and should be submerged four feet.

The action of this valve is as follows: When the vacuum is lost the barometric column at once falls, and the steam forces its passage through the tail pipe and out through the free exhaust outlet. As this is a certain distance above the water outlet openings at bottom of tail pipe, the steam is prevented from blowing out through the hot well and around the buildings.

Dry Air Pump.

As no entirely satisfactory air pump was found on the market, the Waterous Engine Works are building an air pump of their own design to use in connection with the Helander condenser. This pump is of the rotative crank and fly wheel type, and is made with both slide and Corliss valves. With the smaller condensers, where the total amount of steam used by the auxiliary machinery is small, the slide valve air pump shows the best results, and is usually furnished, but with the larger condensers the steam consumption of the air pump is no longer a negligible quantity and the Corliss gear, with its better economy, is employed. The pump is of heavy construction, and so designed that it can run for long periods without overheating the bearing or valve, and the use of a positively driven air valve prevents possibility of atmospheric leakage in operation. Where it is not desirable to drive the circulating pump with a motor or engine, a compact arrangement is offered by belting this air pump to the centrifugal pump supplying the injection water to the condenser; thus reducing first cost. And, as it is not essential that the air pump be located very close to the condenser, it is possible to instal the air and water pumps in the main power house under the immediate supervision of the power operators.

General theory and actual practice have demonstrated a saving of at least 25 per cent. in coal cost alone, by condensing, and in some cases far more than this has been attained. With the gradual increase in fuel prices, the saving in a single year from changing to condensing operation is more than sufficent to pay for the instalation of the condenser. In addition to the saving in fuel, there is a large saving in boiler capacity, plant maintenance and fire-room labor.

For example: Assume a plant of 2,000 I. h.p. operating 24 hours per day, 310 days per year. Coal per I. H. P. per hour, non-condensing operation four pounds. The coal, then, per day of 24 hours is 2,000 I. H. P.x4x24 equals 192,000 pounds, or 96 tons.

With coal at $2 per ton, this amounts to $192 per day. With the instalation of a condenser and a decrease in coal consumption of 25 per cent. there will be a saving of 25 per cent. of $192, or $48 per day, which in 310 days amounts to $14,880.

This is based on coal cost alone, and no account is here taken of saving in coal handling, fire-room expense and boiler maintenance or repairs due to lesser amount of coal fired

News of Societies

Officers of Engineering Societies
and Current News of Associations

OTTAWA NO. 7, C. A. S. E.

The Ottawa No. 7 lodge of the C.A.S.E. meet every first and third Thursdays of each month in Union St. Joseph Hall, 325 Dalhousie St. Papers are read and discussed at each meeting, and the meetings are becoming more enthusiastic the membership increasing rapidly.

On Feb. 3, Geo. I. Scott, chief engineer of the Ottawa E. R. steam power house, read a paper on the Westinghouse Parsons Steam Turbine. His lecture was illustrated with a number of sectional drawings explaining the turbine in detail.

F. J. Merrill, 53 Bayswater Ave., is Rec.-Sec. of the Ottawa lodge.

OWEN SOUND C. A. S. E.

Owen Sound Lodge 25, of the Canadian Association of Stationary Engineers, met on Jan. 27, in their hall over Spragge's store to enjoy a social evening, The engineers to the number of about forty, spent the forepart of the evening in games and discussion, after which a lunch was served. A good programme was next in order, and the members departed feeling that they should meet more frequently in future. This was the second social evening since the inauguration of the lodge three years ago.

CIVIL ENGINEERS.

The following officers were elected at the recent annual meeting of the Canadian Society of Civil Engineers :—President, N. H. Ruttan, Winnipeg ; vice-presidents, W. T. Tye, C. H. Rust, and R. W. Leonard ; councillors, C. R. Coutlee, Phelps Johnson, H. J. Cambie, D. Macpherson, A. E. Doucet, L. A. Herdt, J. A. Bell, C. E. W. Dodwell, C. N. Montzerrat, J. G. Sullivan, A. W. Campbell, J. M. R. Fairbairn, J. M. Shanley, H. H. Vaughan, W. J. Francis, J. E. Hardman, S. E. Haultain, H. G. Kelly, R. J. Durley, and R. S. Kelsch.

QUEBEC CIVIL ENGINEERS.

The members of the Quebec Branch of the Canadian Society of Civil Engineers elected the following officers at their recent annual meeting : President, Capt. A. E. Doucet ; Secretary, P. E. Parent ; Members of Council, Messrs. Vallee, O'Donnell, E. A. Hoare, Decary and A. Leofred. On the conclusion of the meeting, the members adjourned to the office of Mr. Leofred, where they enjoyed his hospitality and spent a pleasant social time.

TORONTO ENGINEERS' CLUB.

The organization of a new club for technically-trained men has been effected in Toronto. A. W. Campbell, Deputy Minister of Railways and Canals, presided at the initial meeting.

The primary object of the new institution is to bring together, in one building, the several technical societies of Toronto, with a common lecture room, library and social privileges.

The following provisional directors were instructed to obtain a charter, secure quarters, and make other necessary arrangements :—Dean Galbraith, A. W. Campbell, C. M. Caniff, J. G. Sing, Willia Chipman, Cecil B. Smith and J. G. G. Kerry, representing the civil engineers ; J. B. Tyrrell and Prof. H. E. T. Haultain, representing the mining engineers ; A. F. Stewart and R. A. Baldwin, railway engineers ; R. G. Black, Wm. A. Bucke and W. H. Eisenbeis, electrical ; Chas. W. Dill and W. E. Douglas, engineering contractors; N. H. McLeod, structural ; T. S. Scott, municipal ; A. J. Van-Nostrand and Capt. Killaby Gamble, surveyors ; Geo. W. Gouinlock, John A. Pearson and Acton C. H. Bond, architects ; J. P. Murray and A. Burton, chemical industries, and K. A. Mackenzie, C. H. Heys, E. A. James and H. L. Drayton.

UNIVERSAL CRAFTSMEN.

At the annual meeting of the Universal Craftsmen Council of Engineers (Canada Council), the following officers were elected: Past Chief, Chas. Moseley; Chief, Thos. Cole; Asst. Chief., H. Terry; Secy. Albert Slaute; Finan. Secy., W. Tait; Treasurer, G. Wilkie; Conductor, J. Carr, and Inside Guard, Grant.

Banquet of Stratford Lodge Stationary Engineers

The First Annual Banquet of Stratford Lodge No 35, C. A. S. E., Held at Albion Hotel, Feb. 4, was Well Attented and was a Big Success.

The first annual banquet of the Stratford Lodge, C A.S.E., held in the Albion Hotel, Stratford, was a big success both in point of attendance and enthusiasm. A tasty menu was prepared as follows :—

Menu.

New York Counts
Soup
Clam Chowder
Fish
Baked Halibut, Matre de Hotel
Relishes
Celery, Radishes, Queen Olives
Entree
Charlotte Russe
Roasts
Turkey, Cranberry Sauce
Roast Beef, Brown Potatoes
Vegetables
Asparagus Tips, Cauliflower, Cream
Mashed Potatoes
Pastry
Strawberry Short Cake, Whipped Cream.
Ice Cream
Assorted Cake
Dessert
Oranges, Bananas
Mixed Nuts Layer Raisins
MacLaren's Imperial Cheese
Tea Coffee Milk

After justice had been done to the repast prepared by H. H. Henders, the following toast list was carried out :—

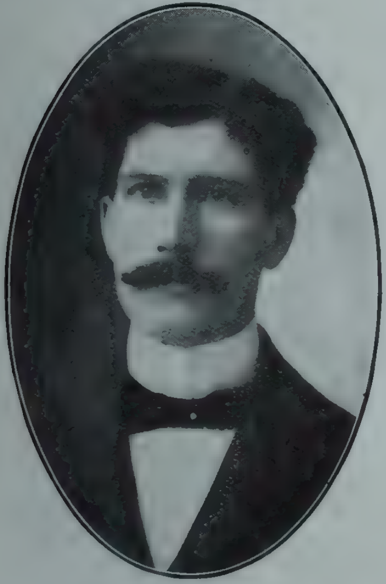
Toast List.

Chairman's Address—J. A. Robertson
The King
"God Save the King"
Corporation of the City of Stratford
Mayor Dingman and Robt. Patterson
Song—Fletcher Johnston
Board of Trade
J. J. Mason
The Association
A. M. Wickens and W. A. Crockett
Song—A. R. Benson
Manufacturing Interests
Wm. Preston and Geo. McLagan
Legislature
James Torrance, M.P.P.
Song—George Sarvis
Canada
Dr. J. P. Rankin, M.P.
Educational Interests
Dr. S. Silcox and D. A. McLachlan
—Song—Mrs. G. W. Hird
Subordinate Lodge
W. G. Walters and A. Kastalla
The Ladies
Geo. Fowler and W. Norris
The Press
G. C. Keith, M.E., Toronto
Roger Roberts' Orchestra
Mrs. J. A. Robertson, Accompanist.

In his opening remarks J.A. Robertson, president of the Stratford Lodge, in welcoming the guests referred to the purpose of the banquet in bringing the manufacturers and workmen together.

Mayor Dingman referred to the objects of the C.A.S.E. and hoped that employers would unite with the employe in cementing the bond between them, thus assisting in carrying out the aims of the association. The association he said, should be applauded for its educative features and its co-operative objects. Men should depend on their skill and efficiency to keep their employment.

Robert Patterson, master mechanic G. T. R., Stratford, in replying to the toast of the City of Stratford, expressed the hope that the government would take up the question of technical education in the near future and provide facilities for instructions, which the engineers were now doing out of their own pocket.



J. A. ROBERTSON.

President Stratford Lodge, C.A.S.E.

The Association.

A. M. Wickens in proposing the toast referred to the establishment of a branch of the C.A.S.E. in 1889 and which has been revived under such happy auspices. He traced the work to secure certificates and pointed out what they hoped the government would do shortly in making the certificate worth more to the engineer. He appealed to every man to pursue his ambition to excel in his daily work. The man who does not conscientiously carry out his end in the boiler room, puts a plug in the success and aims of the Association.

W. A. Crockett, executive secretary, in reply pointed out the educational features of the association. The suspicions of manufactuers were disappearing and this is evidence of good work.

Education is a line along which engineers must work. Theory and practice must be coupled if we are to get something that is a commercial success. Manufacturers should realize this and lend their aid. The preamble showed the objects of the association which is to promote knowledge, and night schools would greatly aid in the work. He hoped the governments would do something soon towards technical education.

The Legislature.

Jas. Torrence, M.P.P., showed that the government were assisting the engineer. A labor department had been established at Ottawa, the Dominion Government was taking up the question of technical education, and he could promise would receive the support of the Ontario government. At the present sitting of the legislature he thought that machinery would be provided for the enforcement of the engineers' law.

Dr. Rankin, M.P., in answering to the toast Canada, said the Dominion Government was taking up the question of technical education and he was pleased to see the manufacturers and their workmen were co-operating in this connection.

S. Silcox showed the relationship between engineers and teachers. Engineers must look after their engines, controlling them. Teachers are mental engineers.

Subordinate Lodge.

W. G. Walters pointed out the educatine features of the C.A.S.E. Engineers must keep down the cost of power and in this he should receive the co-operation of the manufacturer. To get into the front rank an engineer must study. He must also keep in contact with other engineers and find out what they are doing for the economic running of power plants.

A. Kastalla also spoke on the subordinate lodge and stated that an engineer must keep on studying for there are always things to learn. He must get the efficiency out of his plant if he is to keep his position. The only way is to study and the C.A.S.E. offers the solution to an engineer's difficulties. They meet for educative purposes and members assist each other in the solving of problems.

The toast to the Ladies was responded to by Geo. Fowler who advocated the formation of ladies' auxiliary organizations.

The Press was responded to by G. C. Keith, editor of The Power House, Toronto. He showed the value of the technical press and presented statistics to show how the technical press was giving ideas, which if followed by engineers, would result in greater economy in the power plant.

Sparks.

The committee, Alex. Scrimgeour, J. Robertson, G. W. Hird, J. A. Innes, A. Kastalla and W. G. Walters, are to be congratulated on the success of the banquet.

Smiling Geo. Moll, accompanied by J. O. B. Latour, Geo. D. Fowler, and Mr. and Mrs. Fred Campbell, were the London visitors. The other visitors were W. A. Crockett and Miss Crockett, Hamilton ; Mr. and Mrs. J. Passmore, Hensall ; J. Edwards and W. J. Paynter, St. Mary's ; A. M. Wickens, and G. C. Keith, editor of The Power House, Toronto.

The presence of the ladies showed the wise and progressive policy of the C.A.S.E.

W. G. WALTERS.

Secretary Stratford Lodge, C.A.S.E.

Geo. D. Fowler's suggestion was a good one.

A. Kastella made the speech of the evening if enthusiasm could be counted for anything.

The Stratford Lodge is composed of progressive engineers.

W. A. Crockett and W. G. Walters were the orators of the evening.

Water Softener Market.

"On account of the vast Gypsum deposits in Ontario, as well as limestone, the stationary plants must follow the lead of the railroads until every steam plant in the Province of Ontario, and particularly in the west between Toronto and Windsor, must instal a water softening system to remove the scale-forming constituents of the water."—Prof. Bain in address to Toronto Stationary Engineers.

North West Associaton of Stationary Engineers

Third Annual Convention of N.W.A.S.E. held in Edmonton, Alberta, Dec. 28 to 30, 1909—Work of Year was Reviewed and Plans made for the Coming Year

The third annual convention of the Northwest Association of Stationary Engineers was held in Edmonton Dec. 28 to 30, 1909. The delegates were met at the station on Dec. 27 and escorted to the King Edward Hotel, which was the headquarters during the convention.

December 28 Sessions.

The first session was held on Tuesday, Dec. 28, Grand Chief Niven giving the opening address. He reviewed the work of the year and outlined the subjects for consideration during the convention.

Those taking part in the discussion were Grand Vice-Chief MacLean, Grand Sec. Oliver and Grand Organizer Cullen. Mr. Cullen pointed out what had been accomplished during the year and the difficulties which he had encountered in organizing new lodges. In Alberta the distances between centres of population are very great and there are comparatively few industries in the new towns as yet. He had endeavored however, to point out the educative objects of the association so that when the opportunity comes, many new lodges will be organized.

GRAND LODGE OFFICERS AND DELEGATES N.W.A.S. ENGINEERS
Top—Mr. Ellis ; J. Cullen, G. Organizer ; Geo. Inglis ; J. E. Kelley, Door Guard.
Bottom—F. A. MacLean, G. Vice-Chief ; R. Niven, G. Chief ; A. E. Oliver, G. Sec.'y ; J. A. Stewart.

At 2 p.m. the convention adjourned to allow the officers and delegates to visit the Griffin Packing Plant, three miles east of Edmonton, which was reached by the Radial Railway. Chief Engineer O'Donnell took charge of the party and pointed out the many features in connection with it to secure greater efficiency and economy.

The evening session opened at eight with a large attendance of members of the Edmonton Lodge in addition to the delegates. The treasurer's report was read showing that the finances of the grand lodge were in a very satisfactory condition.

The proposed amendments to the Steam Boilers Act, were discussed, it having been found that provisions for the safety of life and property were meagre in the opinion of the association. This discussion was resumed at the morning session Dec. 29 and was continued throughout the sitting of the convention, it being a subject of great importance to the engineers of the province.

December 29 Sessions.

The afternoon session on Dec. 29 was adjourned at four o'clock to allow the delegates to visit the Municipal Power Plant. Superintendent McNaughton conducted the visitors over the whole plant. The original pumping capacity was 500,000 gal., which was soon supplemented by a 1,500,000 gal. pump. A little later a 3,000,000 gal. pump was installed. Mr. McNaughton also showed the new pumping plant, which is entirely separate from the electric generating plant, where a new 6,000,000 gal. pump has just been put into operation.

Opening Meeting for Papers.

The evening session Dec. 29 opened at 8.30, it being an open meeting for all engineers. At this meeting several interesting papers were read.

"Power Production from Incineration," was the subject of an educative paper by J. A. Strocrat, superintendent of the Edmonton incinerator.

"Dangers of the Hydrostatic Test When Applied to Boilers by Careless or Incompetent Engineers," was presented by Grand Vice-Chief F. A. MacLean. Bro. Davidson gave a resume of the best methods of study to be followed by an association. "The Selection of a Power Unit," was a paper presented by Bro. McDonald, after which a brisk discussion took place on the various subjects treated.

The chief business of Thursday was the interview with the Alberta Government re the amendments to the Steam Boilers Act which will receive the consideration of the officials.

Competitive Test.

A subject has been selected for competition among the various lodges of the N. W. A. S. E. This is to take the shape of an essay on "What are the greatest difficulties with which an engineer has to contend." The prizes have been donated by C. C. Snowdon, Calgary, sole agent for America of Potato Scale Boiler Cleanser. Full information in regard to the contest will be given later.

Edmonton was unanimously chosen as the place of 1910 convention owing to the proximity of the Legislative Buildings.

Officers.

The election of officers for 1910 resulted in the return of the 1909 officials as follows :—

Grand Chief, Robert Nivens.
Vice Grand Chief, F. A. MacLean.
Grand Secy., E. H. Oliver.
Grand Door Guard, J. E. Kelly.

Geo. C. Royce, Canadian representative of Ferranti Ltd., makers of Ferranti Meters, etc., 22 Dundas St., Toronto, has appointed E. A. Earle & Co., 532 Pender St., Vancouver, B.C., as British Columbia agents.

NOTICE TO SUBSCRIBERS.

Subscribers will confer a favor on us by notifying us in case they are not receiving their paper regularly, or if they find they have missed one or more issues. We send out thousands of copies each month, and it is only natural to suppose that a few copies will go astray in the mails, even though every precaution is taken by us to avoid this.

We should also be notified at once of any change of address, giving both old and new addresses.

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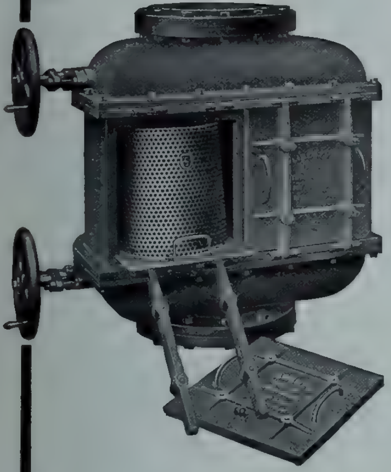
AND THEIR SOLUTION!

IF you have dirt in your water supply keep it out by installing the



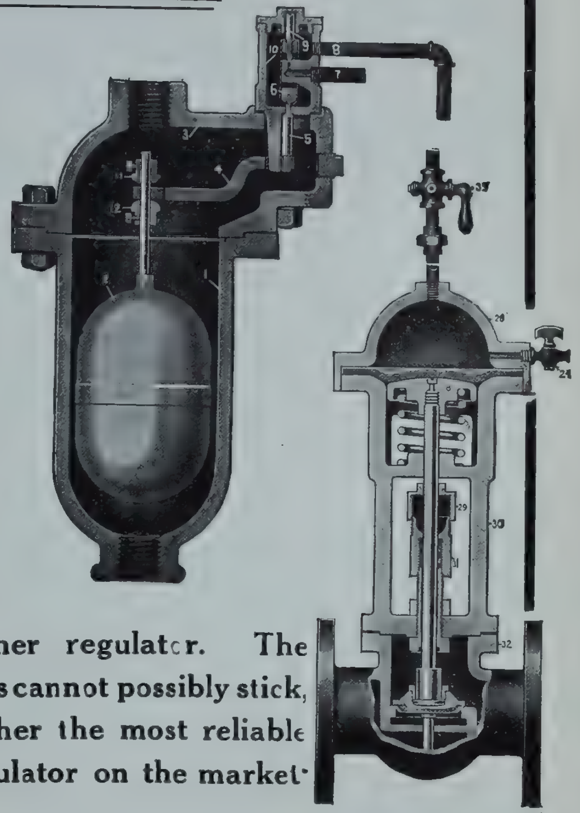
Liberty Twin Strainer

It gives constant service, and while one basket strainer is being cleaned, water continues to pass through the other. Easily opened and operated.

IF your water levels are fluctuating install the

Liberty Feed Water Regulator

It has fewer parts, is simpler in design and more substantially constructed than any other regulator. The actuating devices cannot possibly stick, and it is altogether the most reliable and durable regulator on the market.



IF your boiler tubes are dirty, clean them with a

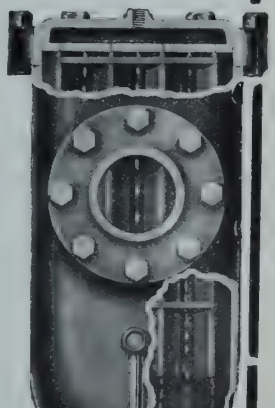
Liberty Cyclone Tube Cleaner

The "Cyclone" breaks up and removes the heaviest scale in less time and with less trouble than any other tube cleaner made.

IF you have trouble with oil in your exhaust steam, install

Liberty-Greenaway Oil Separator

it will take it all out. It can be used with equally satisfactory results on either non-condensing or condensing systems.



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POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

New Brunswick.

ST. JOHN—The wood-working factory of Hamilton & Gay was destroyed by a fire recently, caused, it is thought, by the back draft forcing open the furnace doors. The fire early reached the paint room and an explosion blew the factory doors across the street. Besides the factory the dryhouse and stockroom are badly damaged and, it is estimated, that 200,000 feet of lumber there and 100,000 feet in the factory yard are destroyed. Mr. Hamilton estimates his loss at $50,000. There is $10,000 insurance. The factory will be rebuilt.

Quebec.

DANVILLE—The business of J. L. Goodhue & Co., makers of leather belting and lace belting, which has for the past thirty years been conducted as a co-partnership, has been reorganized under a Dominion Charter, and will be continued under the same management, with Head Office and Factory at Danville.

MONTREAL—Mr. J. E. Aldred, president of Shawinigan Water and Power Co., was named director of the Montreal Light, Heat and Power Co., to fill the vacancy on the board caused by the death of McLea Wallbank. A new office of general manager has been created to be filled by J. S. Norris, secretary-treasurer. J. M. Wilson was created chief electrical engineer and H. S. Lyons comptroller.

MONTREAL—The government of Newfoundland has been in correspondence with the Montreal Board of Trade re refrigeration schemes for marketing products in Europe.

MONTREAL—For the purpose of manufacturing and supplying the Blair "ports" to Canadian blast furnaces, the Blair Engineering Co. has just been incorporated under the Dominion Act. The Blair "ports" have been installed in a number of open-hearth furnaces in the United States resulting in such economy that leading furnace people there are equipping their plants with them. The offices of the Blair Engineering Co., of Canada, are at room 74, Bank of Ottawa Building, Montreal.

Ontario.

BLIND RIVER—The Blind River Light, Heat & Power Co. contemplate extensive additions to their plant. Plans recently outlined include a new concrete power house and the installation of a 300 horse-power turbine. Thomas H. Pindell, Supt.

CHATHAM—The Fruit Growers' Association are considering the establishment of a cold storage plant here.

KINGSTON—The Kingston Shipbuilding Co., which takes over the Government dry dock, on April 15., is making preparations to erect a large building for shops. The structure will be 120 feet long, and two storeys high, it is understood. All the most modern machinery is being purchased, and will be shipped here shortly.

MORRISBURG—Plans are out for a cold storage plant to be erected here.

OWEN SOUND—The Georgian Bay Power Co. offer Owen Sound 1,500 horse power from Eugenia Falls at $20 per h.p. per annum if the town will guarantee the bonds of the company to the extent of $150,000.

OTTAWA—The Imperial Realty Co., which is building a modern apartment house, will have same equipment with a 10-ton motor-driven refrigerating plant, furnished by the De La Vergne Machine Co., New York City.

ORILLIA—Sealed tenders will be received by the Town Clerk until 8 p.m. on Monday, March 7, 1910, for sewage pumping machinery, comprising gasoline engine, electric motors and centrifugal pumps. Plans and specifications may be seen at the office of the Chief Engineer, Mail & Empire Building, Toronto, or Resident Engineer's office, Orillia. No offer necessarily accepted. W. C. Goffatt, Esq., Mayor, Orillia, Ont., C. E. Grant, Esq., town clerk, Orillia, Ont., Willis Chipman, C.E., chief engineer, Toronto, Ont.

PORT ARTHUR—Concessions will be made to a company establishing a cold storage plant at this port. L. C. Neil, Industrial Commissioner.

STRATFORD—From the alternatives possible covered by the Stratford, Ontario, Water Commissioners' recent specifications for turbine pumps and motors they selected the four units clutch coupled on one bed plate, viz., a million imp. gallon pump, and a 100 K.V.A. syn. motor, and a million and a half pump, running at 1,500 r.p.m., with exciter and switchboards ; the power being 2,200 volt, 25 cycle, 3 phase electricity. The Lancashire Dynamo & Motor Co., Manchester, England, and Rees Roturbo Pumps, from Wolverhampton, Eng., will furnish motors and pumps.

TORONTO—The O'Keefe Brewery Co., is adding to the refrigerating plant in its brewery, which consisted of two 50-ton De La Vergne Machines, a 125-ton machine, complete furnished by the De La Vergne Machine Co., New York City.

Manitoba.

WINNIPEG—R. H. Seabrooke, who has been traveling to the coast for the past few years for Harrison & Co., Montreal, dealers in engineering supplies, has opened at 717 Robson Street, the first depot west of Winnipeg devoted exclusively to this line.

Alberta.

CALGARY—Tenders will be received until February 25, for cast iron pipe, valves, hydrants, specials, etc., for the proposed waterworks extension. H. E. Gillis, City Clerk.

EDMONTON—J. Y. Griffin & Co., will improve the refrigerating plant in their packing house here by the addition of a 100-ton refrigerating machine, contract for which was let to the Ice & Cold Machine Co., St. Louis, Mo., U.S.A.

British Columbia.

VICTORIA—The British Columbia Electric Railway Co. has signed a contract involving $53,000, between the Vancouver Island Power Co., and the John McDougall Caledonia Iron Works, Montreal. The latter company agrees to supply to the former the first of the four 4,000 kilowatt units for the former's Jordan River power plant on Vancouver Island. This plant, when completed, will have a capacity of four 4,000 kilowatt units and it is for the first of these that yesterday's contract was signed.

CATALOGUES.

FUEL ECONOMIZER—The Fisher Fuel Economizer, 74 Bay St., Toronto, have issued a booklet giving a description with directions for use of the Fisher Fuel Economizer. Several letters are reprinted showing what has been accomplished with the economizer.

ICE MAKING AND REFRIGERATION—"The Value of the Flooded System and its Application to Ice Making and Refrigeration Plants," is the subject of a bulletin issued by the Vilter Mfg. Co., Milwaukee, Wis. This is a reprint of a paper on the above subject read before the American Society of Refrigerating Engineers at their meeting held at Chicago, Ill., Oct. 18 and 19, 1909, by H. Rossback. The system is explained fully, and forms a complete treatise on the flooded system.

POWER MACHINERY AND MACHINE TOOLS—The A. R. Williams Machinery Co., 95 Front St. West, Toronto, have issued stock list No. 55 which contains 136 pages of illustrated descriptions of engines, boilers, high grade mill and factory machinery, etc., handled by this company. These include machinery manufactured by leading companies in the United States and Canada, and includes all the necessary power and machinery equipment for various factories.

REFRIGERATING MACHINERY—Within the past 40 years mechanical refrigeration has developed to such an extent that it is now an important branch of engineering. In their catalogue No. 5, containing 83 pages, the Kroeschell Bros. Ice Machine Co., 29-39 Erie St., Chicago, make reference to the various systems, carefully explaining and illustrating the Carbonic Anhydride refrigerating and ice making system which was introduced twenty years ago. The catalogue will be sent to those interested on request.

Refrigerating Machinery.

Armstrong Machinery Co., Spokane, Wash., nave issued a neat catalogue of ice and refrigerating machinery showing views of their modern works and its products. Full dimensions, illustrations and prices are given for the Alaskan, Spokane and other types of machines.

SELLING AGENT WANTED
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To handle the great Forced Draft necessity
THE TURBO BLOWER
W. H. ADAMS, P.O. Box 23, MONTREAL

ELECTRIC BARGAINS
We have some GOOD, PRACTICALLY NEW, MOTORS GOING AT A SACRIFICE
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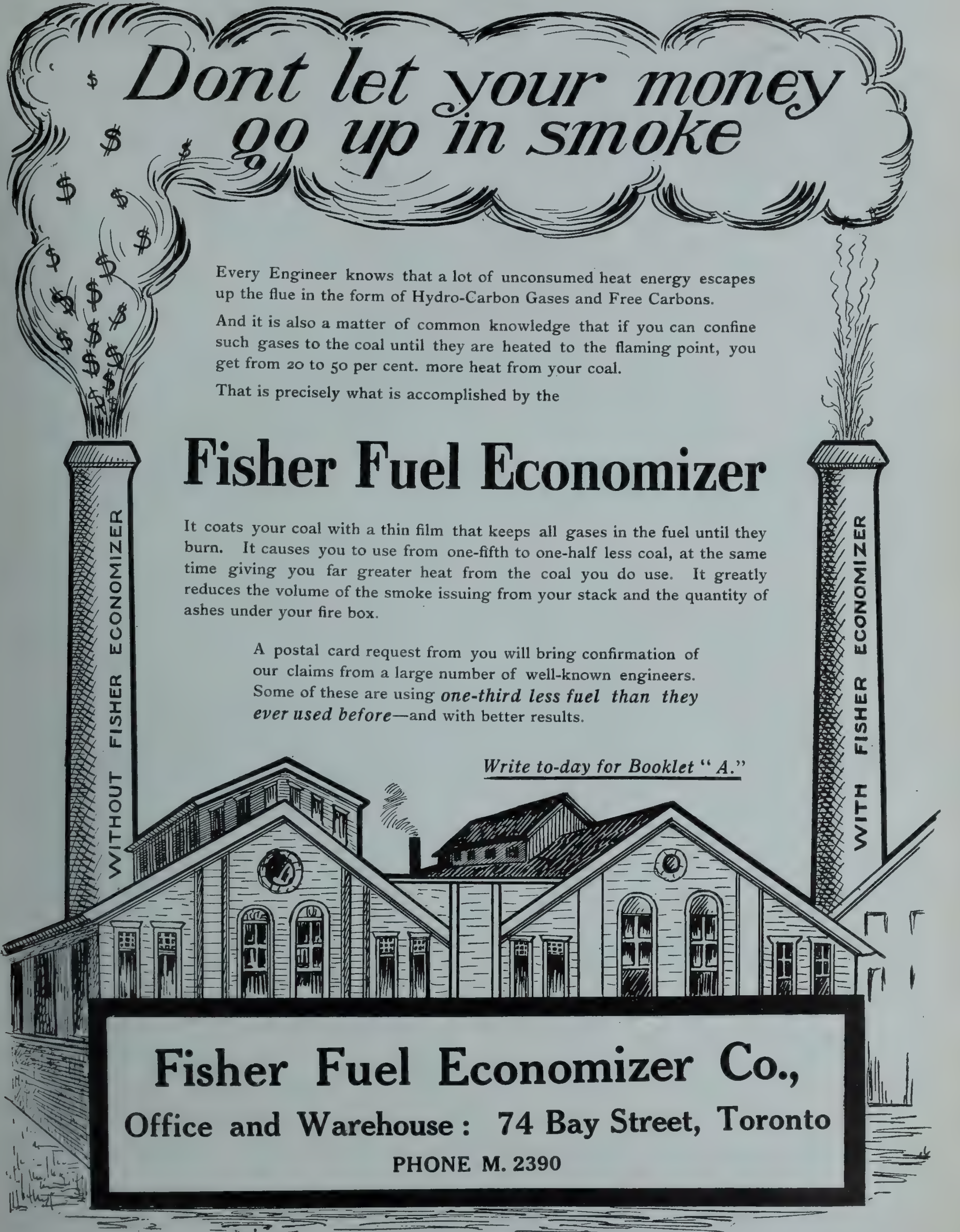


Every Engineer knows that a lot of unconsumed heat energy escapes up the flue in the form of Hydro-Carbon Gases and Free Carbons.

And it is also a matter of common knowledge that if you can confine such gases to the coal until they are heated to the flaming point, you get from 20 to 50 per cent. more heat from your coal.

That is precisely what is accomplished by the

Fisher Fuel Economizer

It coats your coal with a thin film that keeps all gases in the fuel until they burn. It causes you to use from one-fifth to one-half less coal, at the same time giving you far greater heat from the coal you do use. It greatly reduces the volume of the smoke issuing from your stack and the quantity of ashes under your fire box.

A postal card request from you will bring confirmation of our claims from a large number of well-known engineers. Some of these are using *one-third less fuel than they ever used before*—and with better results.

Write to-day for Booklet " A."

Fisher Fuel Economizer Co.,

Office and Warehouse: 74 Bay Street, Toronto

PHONE M. 2390

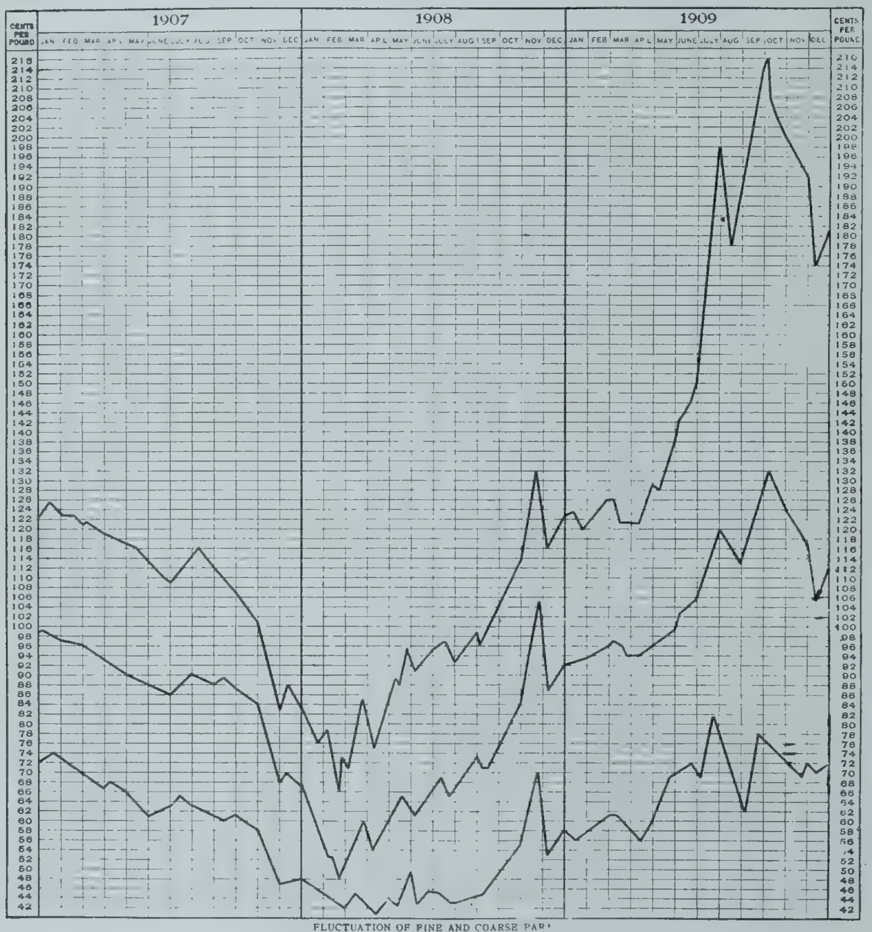
Power Supply Markets

MONTREAL.

The month of January was, comparatively speaking, quiet although the amount of business put through was of a satisfactory volume. February opened up with much better strength due, probably, to the finishing of January inventories. There is considerable demand for quotations on large power apparatus and the gulf between the demand and deliveries is slowly widening.

The amount of inquiries from western municipalities showed a perceptible slackening last month which fact may be laid at the doors of municipal elections, old councils going out and the new coming in. Indications are good, however, and consulting engineers, manufacturers and dealers in all power lines are very optimistic regarding western business.

The Robb-Armstrong Co. have just received an order for a complete 150 h.p. outfit from the Gambo Lumber Co., of Gambo, Newfoundland. Among other orders was one for two vertical engines sold by the Alliss-Chalmers-Bullock Co., to Geo. P. Davie & Son, Quebec. By the way, I hear the Allis-Chalmers-Bullock Co. have been forced to find larger premises for their sales offices and contemplate moving into the Canadian Express Building when "moving day" comes round.



Rubber Statistics, Showing the Fluctuations in Price. Issued by the Raw Products Co., New York.

The City of Lethbridge have ordered a 720 h.p. vertical triple expansion Belliss and Morcom engine from Laurie & Lamb. This is to take the place of the plant which was recently destroyed by fire.

BOILER TUBES.—Prices are in line for an advance owing to the general increase in cost at the mills due to the rise in prices of raw materials. The mills are all heavily booked for months in advance and deliveries are getting slower and slower. Steel plates are in the same condition as the tubes and from the same cause. Imported European plates can be laid down here very much cheaper than Pittsburgh deliveries owing to difference in freight rates. This amounts to 12c. per hundred pounds, it costing 10c. from London or Antwerp and 22c. from Pittsburgh. Local prices in bar iron and steel are up 5c.

The prices of stock boiler tubes are as follows :—2.in. tubes (per 100 feet), $8.50 to $8.80 ; 2½-in., $10.25 to $10.80 ; 3-in., $11.75 to $12.35 ; 3½-in., $13.50 to $14.50 ; 4-in., $18.50 to $19.50.

MECHANICAL RUBBER GOODS—Due to the erratic condition of the crude rubber market the market in these lines is full of interest to those concerned. The prices have been advanced in most of these lines particularly in those which contain a high class of rubber such as valves and packing. The price of rubber belting is still stationary although an advance in the near future would not be surprising. Prices of rubber lined cotton hose have been boosted owing to the continued high level of the cotton market.

The price of crude rubber is up again and brokers are confidently looking for the $2.00 mark by the end of February and as high as $2.50 before April turns into the stretch. The efforts of the price to reach this level will be augmented by the comparatively heavy buying that will probably take place in the spring when supplies for the rubber shoe trade and automobile tire industries will be purchased.

The increase year by year in the world's supply of rubber is not very great although it is increasing each year. In 1907 it was 37,300 long tons, in 1908 38,350 tons and in 1909, 39,031 tons. The average stock on hand at Para has been kept very low and at the end of December 1909 it was only 155 tons—to meet a world's demands. With the conditions existing, only a few of which have been noted here, it is rather a difficult matter to forecast the movements of the crude rubber market. A curve illustrative of the prices for the last two years looks like one of the ranges of the Rocky Mountains with the highest peak at $2.03 in Oct. 1909 and the lowest valley at 66c. in February 1908.

LUBRICATING OILS.—This line shows a marked improvement over last month due to large corporation orders being booked for spring delivery. Business on the whole shows a good healthy condition. The prices are steady as follows :—High grade cylinder oils (imp. gal.), 60c. to 80c. ; engine oils, 30c. to 60c. ; machine and dynamo oils, 30c. to 45c. ; shafting oils 25c. to 40c. ; engine greases (per lb.), 6c. to 12c.

F. C. D. W.

TORONTO.

A visit to the various factories of Toronto shows a fairly satisfactory state of affairs. The industrial bureau shows that many branches of United States companies have been established in Toronto recently with a great number more in sight. Some fair bookings have been made for both steam and electric units. Other municipalities are joining the Ontario hydro-electric scheme and more large orders for electrical equipment will result. It is possible that other transformer stations will have to be built to take care ol towns that are deciding to take power from the Hydro-Electric Commission's lines.

BOILERS.—The boiler business is in a very satisfactory state. Difficulties are found in boilers for Alberta especially in traction engines but it is expected that the new regulations will be adopted shortly and this trouble will be eliminated.

BOILER TUBES.—Lap welded steel per 100 ft., 2-in., $8.50 to $8.75 ; 2½-inch, $10 to $10.75 ; 2½-inch, $10.65 ; 3-inch, $11.50 ; 3½-inch, $14 and 4-inch, $18.50 to $19.

COAL.—Retail price for Pennsylvania hard, $7.25 net. This price applies to grate, egg, stove and chestnut ; pea coal is $6.00. These are cash. Run of mine coal is quoted at $3.60 to $3.75 ; slack, $2.50 to $2.85 ; lump coal, $3.40 to $3.70 ; cannel coal at $7.50 per ton.

MECHANICAL RUBBER GOODS.—The accompanying table shows the fluctuations of fine and coarse rubber during 1907, 1908 and 1909. During 1909 the United States imported 33,275 tons of 2,240 lbs., England imported 10,189 tons, Antwerp 4,789 and Bordeaux, 1,994 tons. This table is issued and copyrighted by the Raw Products Co., 121-123 Front St., New York, and is reproduced by permission. The upper line shows fluctuations of Upriver Fine ; middle line, Upriver coarse ; and lower line, Island coarse.

At the present time reports are conflicting but an upward tendency. Upriver fine was quoted at $1.92 in New York on Feb. 11, 1910, but to-day (Feb. 14), prices are about $2.00 and the high price of Oct. 1909, $2.16, may again be reached. Liverpool prices are also advanced. With the demand from the raw product that it is anticipated for 1910, a high price will probably be maintained throughout the year 1910.

LEATHER BELTING.—The request of oak backs exceeds the supply and consumers are having difficulty in getting needs even for current requirements. High prices prevail for the better grades and much material ordinarily cheap is selling at good values. Manufacturers are not anticipating their needs in belting butts and tanners find some difficulty in getting bulk trade. Prices are first at 43, seconds at 40 and thirds at 38.

LEAD WOOL.—Price $10.50 per 100 lbs. and $200 per ton.

FIRE BRICKS.—Scotch and English, $30 to $35 ; American, $25 to $35 per 1,000.

Don't Waste Your Fuel

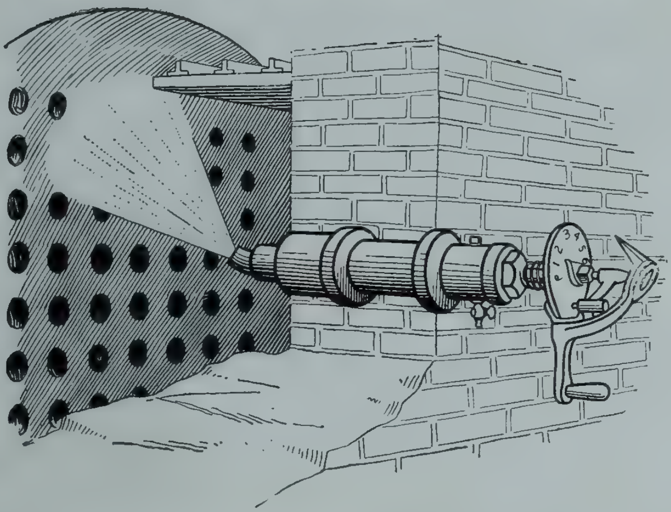
SAVE IT

It requires 140 times as much heat to penetrate a given thickness of soot as it does to penetrate the same thickness of boiler casing.

Keep Your Boiler Flues Clear of Soot
ALL OF THE TIME by Using the

"DIAMOND" STEAM FLUE BLOWER

Blows with the Draft



Uses Dry Steam

In five minutes with a "Diamond" Blower you can blow the soot entirely out of your boiler. A few minutes every day keeps your boiler clean and in fit shape to give you every possible ounce of energy out of the fuel.

The Least Coating of Soot in the Flues Means
Heat Wasted—Heat Means Fuel—Fuel Means Money

Unless the soot is cleaned out of your boiler every few hours

You are Wasting Money

THE "DIAMOND" STEAM FLUE BLOWER blows the soot with the draft out of the boiler entirely—no accumulation in the combustion chamber or breaching—but out of the stack, even though it be 125 feet high.

25,000 "DIAMOND" BLOWERS ARE NOW IN USE

SOLD ON THIRTY DAYS' TRIAL

Agents selling "Diamond" Steam Flue Blowers are making money fast. We have some territory in Canada which is not covered. If you are a good salesman, and are interested in a high grade proposition, write for particulars to

THE "DIAMOND" POWER SPECIALTY CO.

DETROIT WINDSOR, ONT. BERLIN

"Diamond" Power Specialty Co., 222 Fort St., Detroit.

Gentlemen:—Without obligating me, you may send me free a copy of your book "Economical Production of Steam," which I understand is a practical treatise on the operation and maintenance of the "fire tube" type of boiler.

Name...

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Employed by..................................

Number and capacity of boilers in operation.............................

The advertiser would like to know where you saw his advertisement—tell him.

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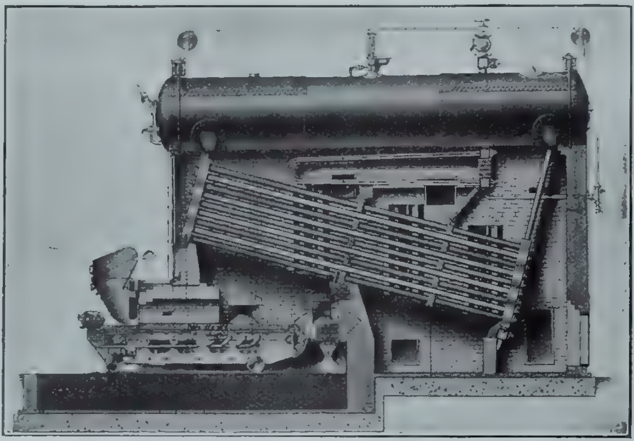
"B. & W." PATENT WATER TUBE BOILERS

With Furnaces for all Classes of Fuel or Waste Gases

HIGHEST ECONOMY, SAFETY, DURABILITY OVER 7,000,000 H.P. IN USE



Babcock & Wilcox Patent Water TubeBoiler, Superheater, and Mechanical Stoker

ALSO

Steam Superheaters
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Coal-Handling Machinery
Piping, Feed Water Heaters
Water Softeners and Purifiers
and ELECTRIC CRANES

Our Book "STEAM" sent on request

HEAD OFFICE FOR CANADA - NEW YORK LIFE BUILDING, MONTREAL
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THREE WEEKS vs. SEVENTEEN MONTHS

OR WHAT WAS SAVED BY USING

MAGNOLIA ANTI FRICTION METAL

He had to re-babbitt his bearings 25 times in seventeen months with the old metal.

He used, say, 20 lbs. each time, or, say, a total of 500 lbs. at, say, 25c lb.	$125.00	
He expended, say, 50 hours' labor at 50c hour	25.00	$150.00
Credit by 20 lbs. Magnolia at 25c lb. + $1.00 labor		6.00
Difference in favor of Magnolia, in 17 months		$144.00

This would make value of Magnolia Metal as compared with the old metal, equal to $7.20 lb., not to mention the saving in oil, etc., and the evenings spent in the engine room.

St. Louis, Mo., July 24th, 1909

MAGNOLIA METAL CO.

Dear Sirs: I am in receipt of your postal and blotters and will say that I was one of the first engineers that ever used your metal; also was acquainted with Mr. Samuel Singley, the inventor of above metal. I used it on crank pin on a 250 H.P. roller engine in the McDonald Steam Forge and Rolling Mills in this city in 1881. This crank pin gave me a great deal of trouble and never was able to hold babbitt in it longer than three weeks until I tried your metal, and it lasted seventeen months without giving me any trouble; it just wore out, and in all this time I haven't used any other kind of metal in any kind of bearings. The first Magnolia I bought of Ward & Brady Boat Store, of St. Louis, Mo,

Yours very truly,
ADAM F. BERMENE,
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We have a small supply of **Practical Engineer Pocket Books** containing 680 pages and treating on over 2,000 Engineering and Mechanical subjects. We offer this valuable book at the very low price of 40c, postage prepaid. It is invaluable as a reference work. Let us know if you will want a copy.

If Your Dealer Does Not Keep Magnolia and Will Not Order, We Shall Be Pleased to Supply Your Requirements. Send Reply to Montreal Office.

Magnolia Metal Company

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Chapman & Walker, Ltd., Toronto
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Waterous Engine Works Co., Brantford

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Jenckes Machine Co., Sherbrooke, Que.
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Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Saw Mill.
Goldie & McCulloch Co., Galt.
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Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
Sight Feed Oil Pump Co., Milwaukee, Wis.
Sterling Lubricator Co., Rochester, N.Y.

Lubricators, Plain.
Detroit Lubricator Co., Detroit

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Jones Underfeed Stoker Co., Montreal.
Standard Engineering Co., Toronto

Meters, Electric
Canadian Westinghouse Co., Hamilton
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Meters, Water
Drummond, McCall & Co., Montreal
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Allis-Chalmers-Bullock, Ltd., Montrea
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Jno. McDougall Caledonian Iron Works, Montreal
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Allis-Chalmers-Bullock, Ltd., Montreal
Jno. Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

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Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Electrical & Motor Co., Toronto
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
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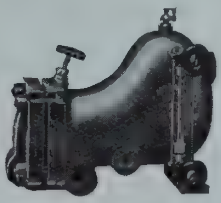

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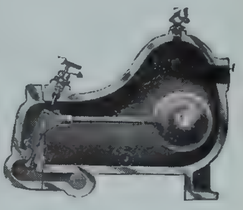

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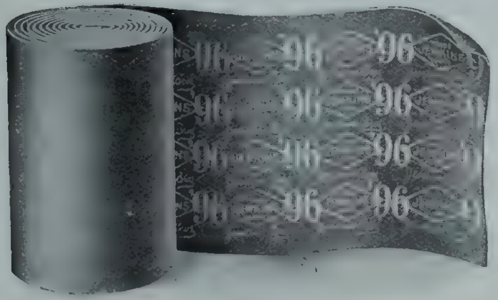

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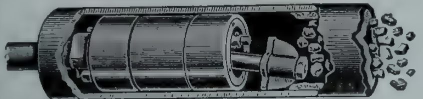

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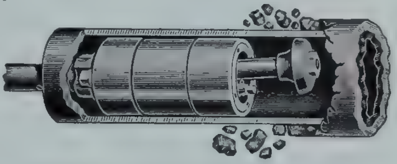

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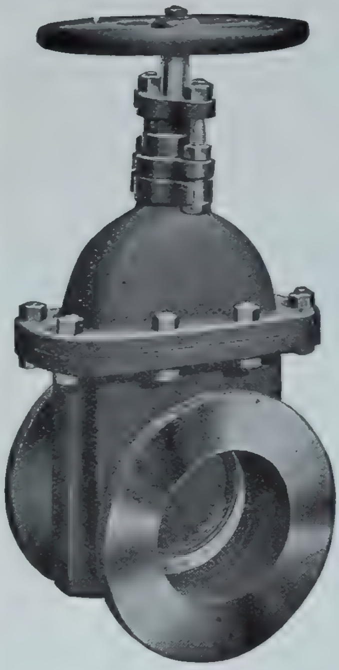

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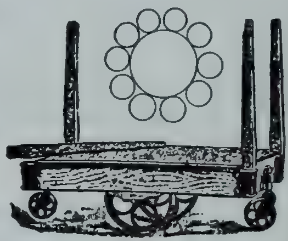

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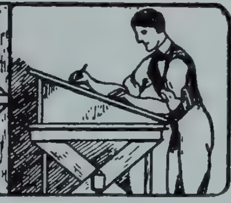

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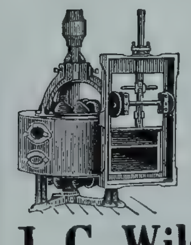

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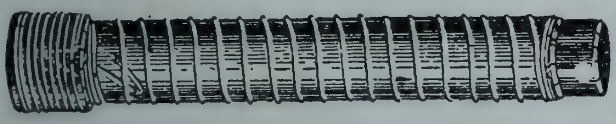

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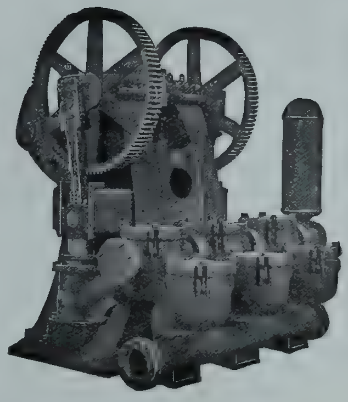

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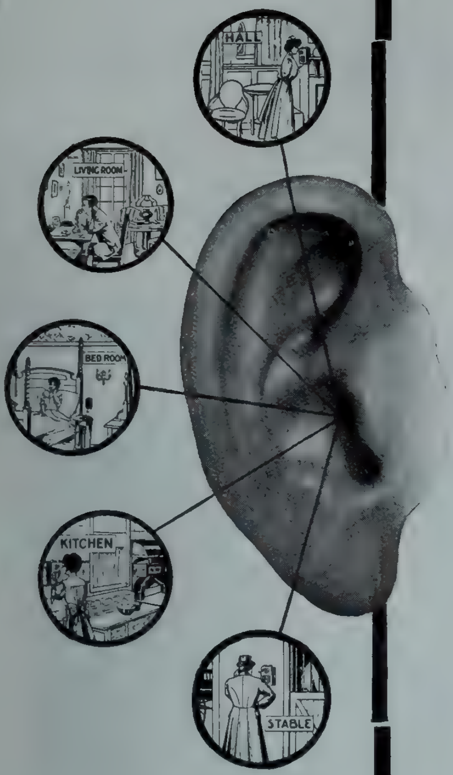

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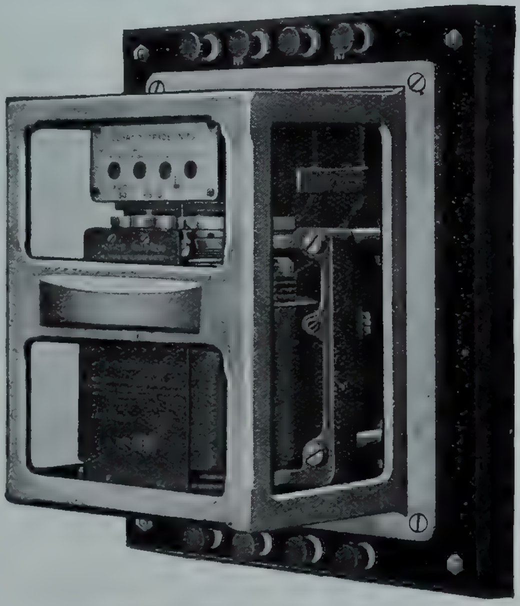

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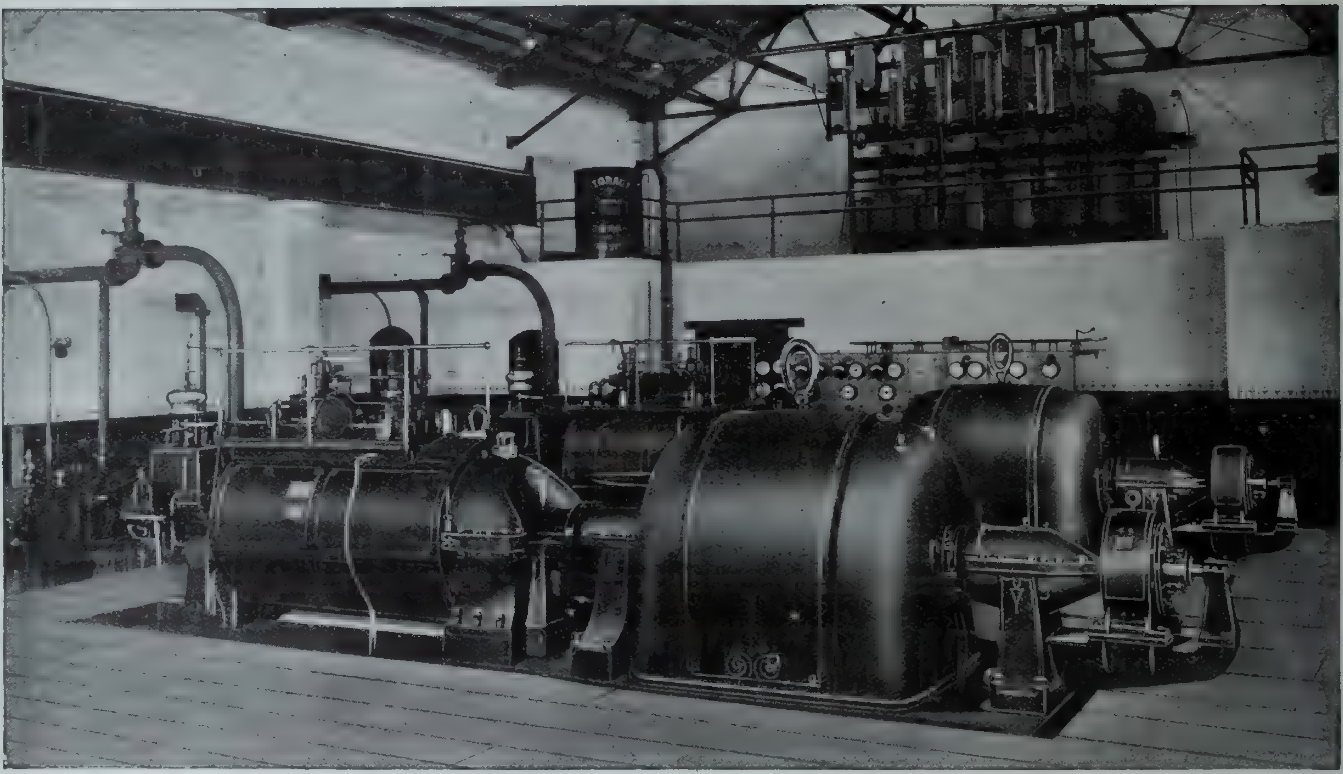

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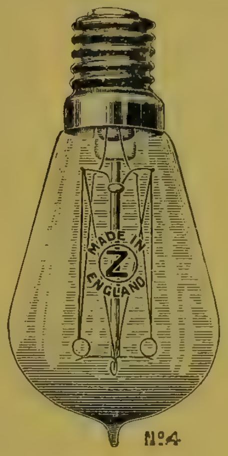

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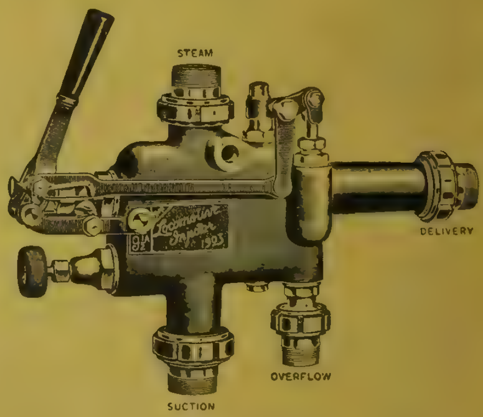

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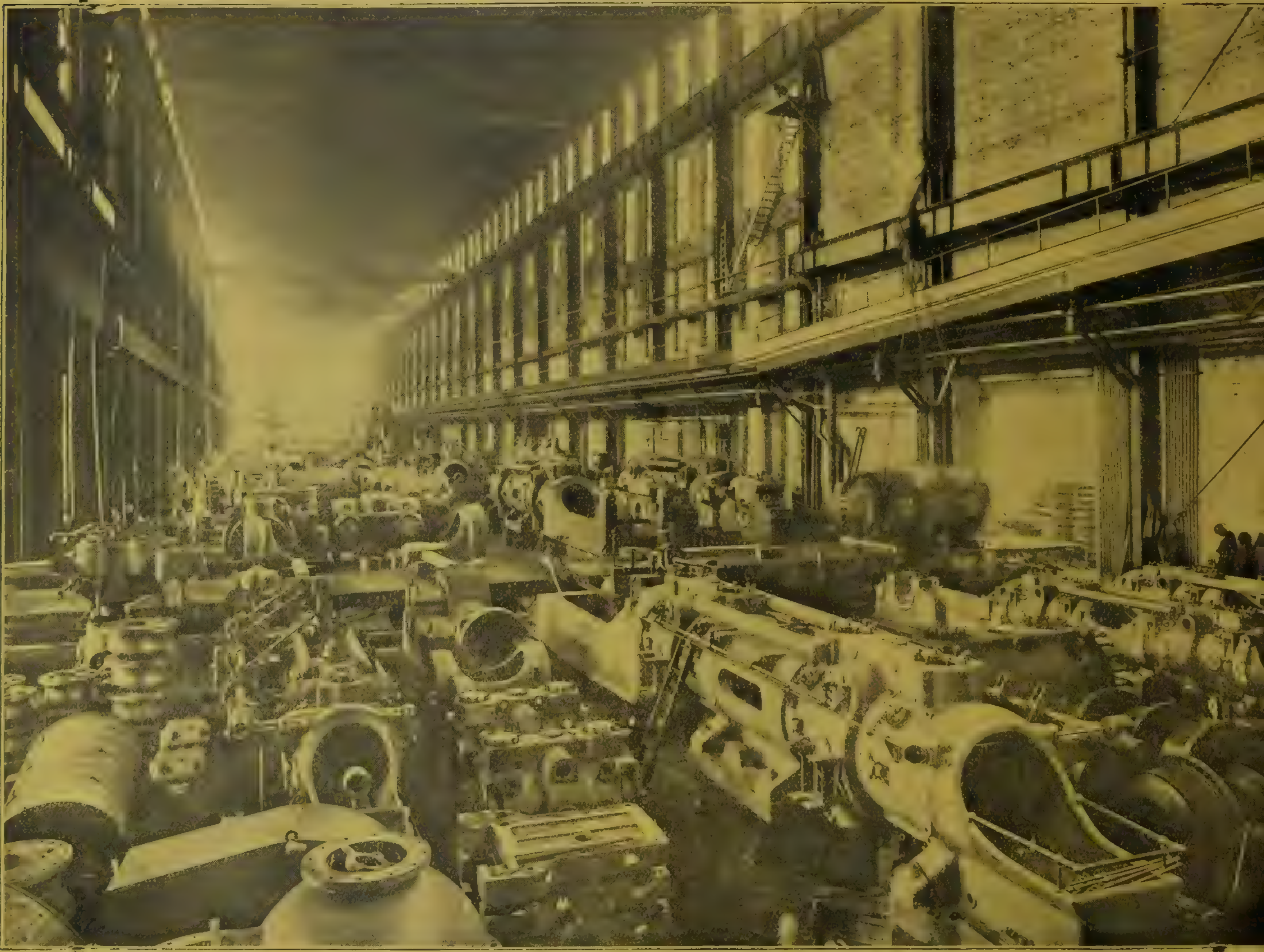

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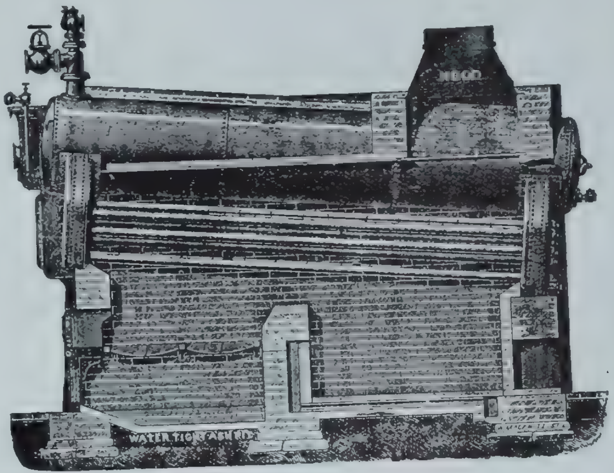
Fig. 1—Heine Boiler and Setting

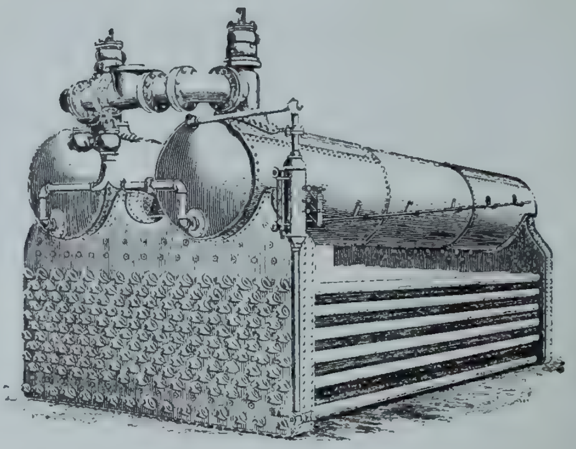
Fig. 2.—The Heine Boiler Without Brick Setting

Durability, Efficiency and Safety

These are three features in which the

Heine Safety Boiler

is distinctly superior to every other make. In point of economy and capacity, for constant and uninterrupted water circulation, it is the best on the market for every sized plant, from 100 h.p. up.

The "Heine" Boiler is constructed so that not only will it best absorb and transmit heat, but also so that heat will best reach it.

Every test, including those of the utmost severity, is applied to each tube and plate of the "Heine" Boiler and, moreover, the whole boiler is completely set up and tested before shipment. Its safety can therefore be positively guaranteed.

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Lunkenheimer Oil and Grease Cups

The cups can be regulated to feed any desired quantity of oil or grease, and the flow is steady and positive.

Jarring of the machinery to which they are attached will not shake them to pieces, nor will it affect the setting of the feed.

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Largest Manufacturers of High-Grade Engineering Specialties in the World.

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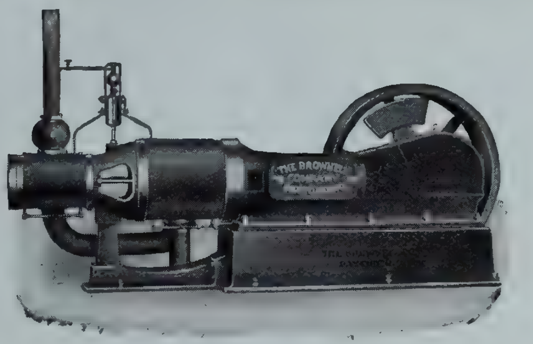

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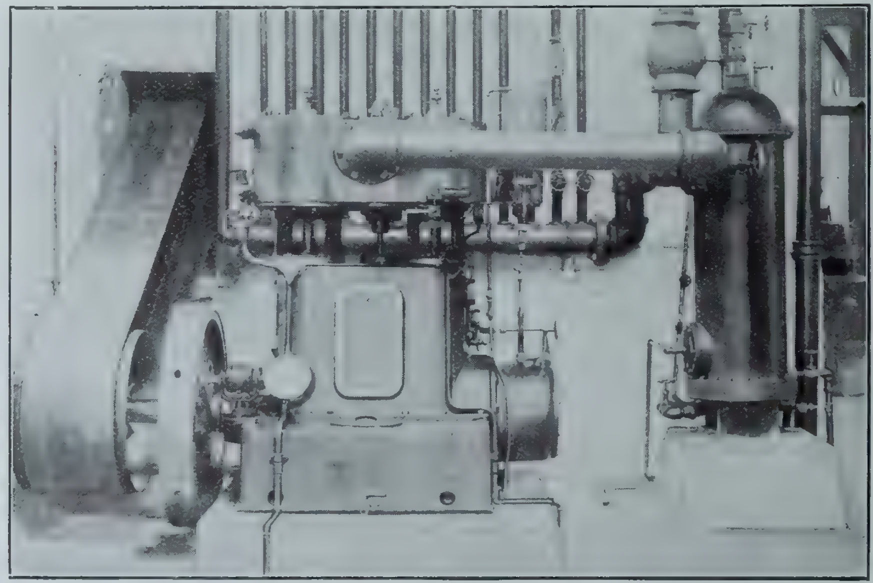

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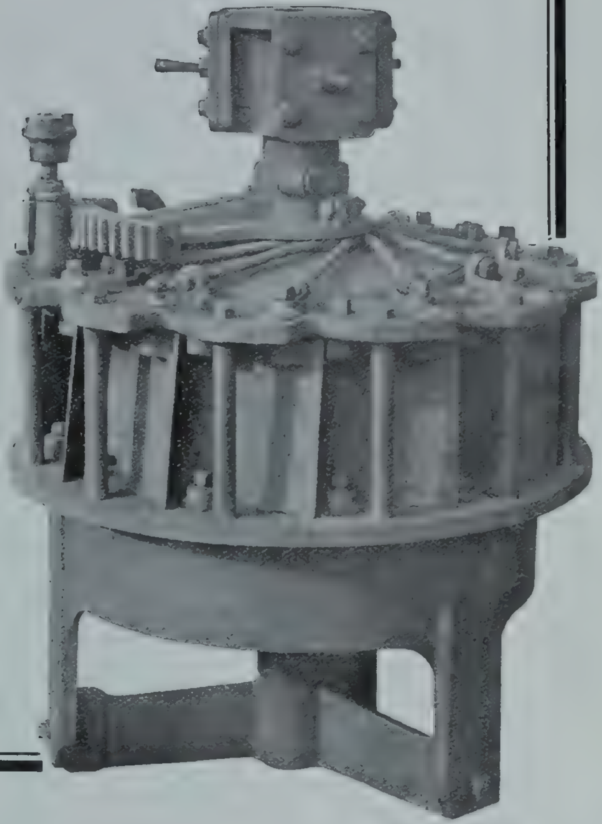

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If there is any water near you that you can use, write us. We can harness it for you in the best possible manner.

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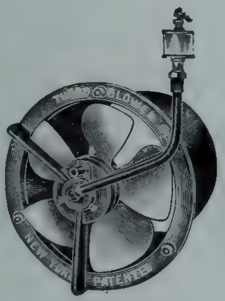

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"The Turbo-Blower"

It will give from 30% to 40% more power, and with cheaper coal at that.

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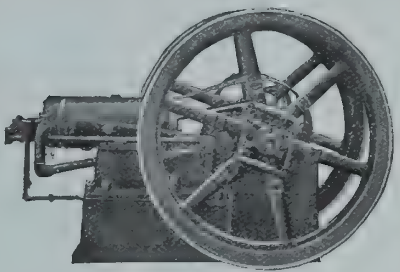

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You can absolutely depend on an I.H.C. Engine to do the work right—at the lowest price. Thousands of power users have found I.H.C engines to be most dependable, simple, economical, powerful and durable. You will too. There is

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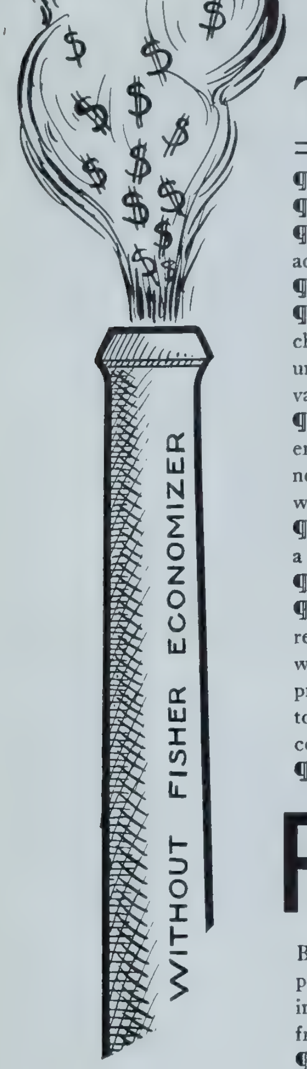

THE COST OF SMOKE

¶ What proportion of the coal fed to the locomotive is actually used in power?

¶ About 6 per cent.; the rest is wasted.

¶ What part of the fuel value of their coal do the furnaces of the great manufacturing plants actually apply to driving the machinery?

¶ Not over 10 per cent.; often less.

¶ The rain of cinders from the locomotive, the pillar of black smoke from the factory chimney, account conspicuously for the waste. The great loss, however, is in the form of unconsumed gases which escape into the air without having been of any steam-producing value.

¶ These gases escape because, as is well known, perfect combustion has never been discovered as yet. The gases escape from the coal so rapidly that, before they are mixed with the necessary air (providing oxygen) they have passed away from the point of combustion—which is at the surface of the burning coal.

¶ The rescue of a small proportion of the 90 per cent. of fuel value thus wasted would mean a large proportion of the 10 per cent. now ordinarily used.

¶ This should be easily done.

¶ It has been done, and is being done. It can be done in every plant—in yours with the rest. Chemistry has produced in the *FISHER FUEL ECONOMIZER* a substance which when applied to the coal forms an exceedingly thin film over it and causes the valuable heat-producing gases to be held in the coal itself, and the coal and the gases are consumed together, thus preventing the waste of valuable gases which take place when the coal is consumed without the treatment.

¶ Indisputable evidence is available that by the use of

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Black smoke and flying cinders are eliminated, which has been proved on locomotives pulling the fastest passenger as well as the heaviest freight trains. Many evaporation tests in the power plants of the largest corporations in Canada show increase of efficiency ranging from 10 to 25 per cent.

¶ We save money for the factory owner and railway.

¶ We save the fireman much hard and dirty work.

¶ We save the black smoke which pollutes the air.

¶ We reduce your ashes and clinkers half.

¶ We increase and maintain steam to a degree which is impossible without the economizer.

¶ We keep your boiler tubes and grate bars clean, reducing expense of upkeep.

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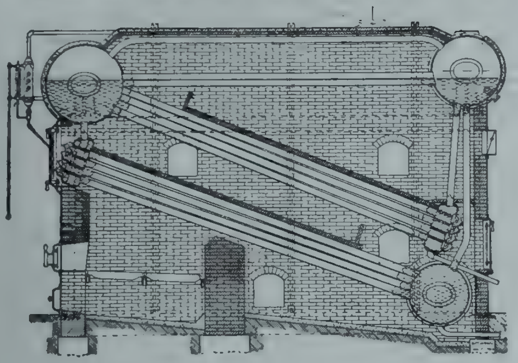

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Perfect water circulation

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This composition will possibly keep your Boiler from foaming, and is guaranteed not to injure boiler pipes, shell or connections.

Send me one gallon of your feed-water, and I will supply a compound that will keep your boiler clean without damage.

Send To-day. NO CURE—NO PAY

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DON'T "TINKER" WITH THE SCALE PROBLEM

There is only **one** way to take care of this problem properly—tackle the scale-forming elements in your feed water BEFORE they have formed—NOT AFTER. Mechanical cleaners are good in their way, but what good are they unless there is scale in the boiler to clean out?

DEARBORN TREATMENT

PREVENTS Scale Formation by acting directly on the scale-forming salts in your water. The "Dearborn" Method has proved so enormously successful, because each case is **treated individually**. We find out by analysis exactly what your feed water contains and then make up a compound that will kill everything injurious in that water.
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Is Worth a
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Catalogues and full information are at your disposal.

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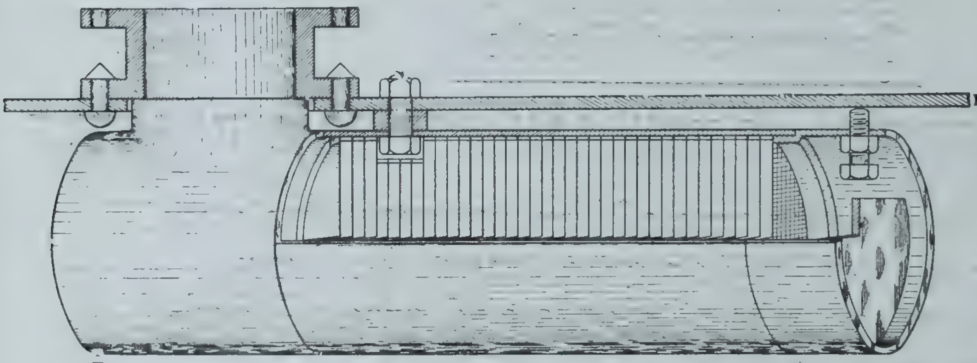

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is of such vital importance to the modern engineer as the delivery of steam to the piston free of entrained water and foreign matter.

The Ideal Internal Steam Separator

is an absolute safeguard against accident to your engine by water shock or the going out of cylinder heads. IT MAKES FOR ECONOMY by saving oil, packing and time and lessens the wear and tear of engines, pumps and compressors. This system of separation at the initial point fills a long-felt want and appeals to the up-to-date engineer.

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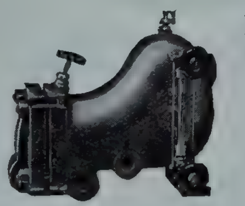

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FOR HIGH OR LOW PRESSURE.

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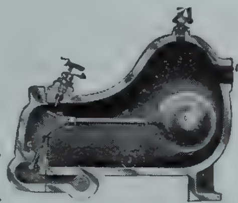

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Everyone operating a Stationary Steam Plant of 50 h.p. or over, in the Province of Ontario, must hold a Certificate from this Board. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary Engineers' Act

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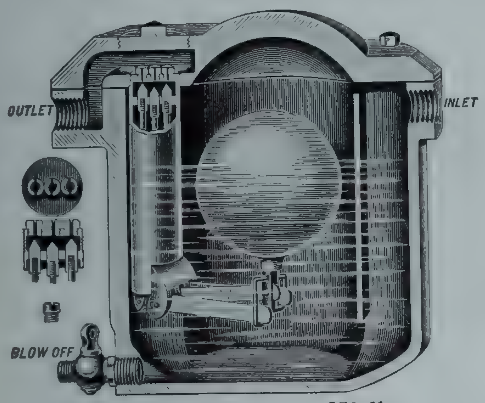

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STEAM TRAP

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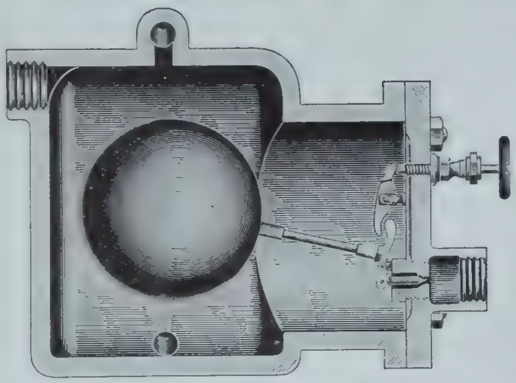

Just take a moment and examine this sectional view of the "Reliance" steam trap. Could anything be simpler? The

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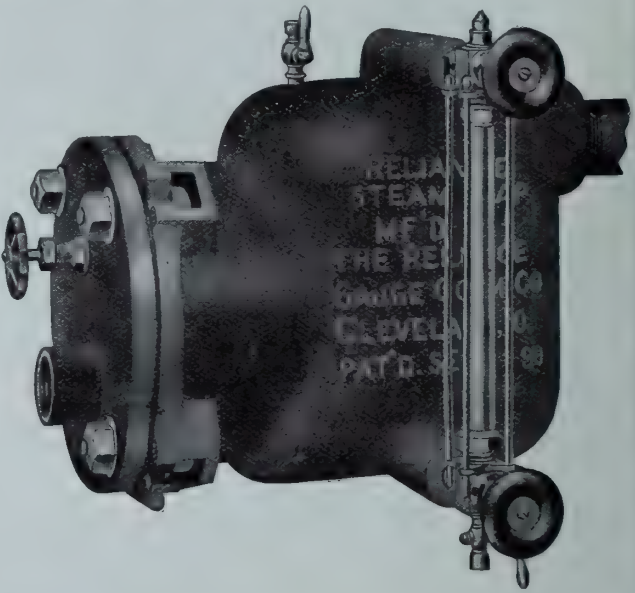

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The Reliance Gauge Column Co.
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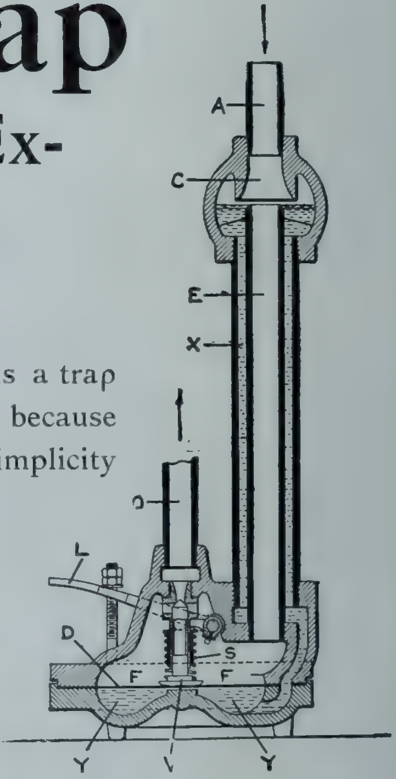
The Flinn Trap

No Buckets, No Floats, No Expansion, No Joints to Pack, NO TROUBLE.



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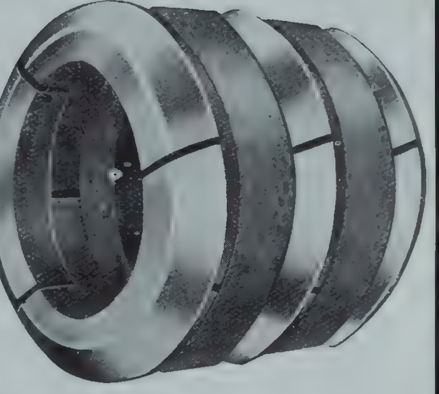

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Steam Traps

The Original and Best Tilting Steam Trap on the market

Service record
20 Years

IN a four-inch steam pipe 60 feet long, in one hour the condensation, under fair weather conditions, will amount to 30 pounds of water. In winter the value reaches 90 pounds and over per hour.

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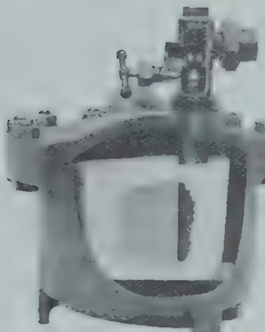

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Get our price on this one— It is ridiculously low.

Made by the
Inventors
of the
First Return Trap

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depends upon the method of boiler cleaning employed. Perhaps you'd like to know how to promote economy in YOUR Boiler room. We've been in the boiler cleaning business 12 years and we think we know a few things along this line which you may not. For instance, we have learned that compounds neither prevent nor remove scale. Then we know that

The Dean Boiler Tube Cleaner

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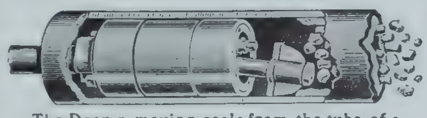
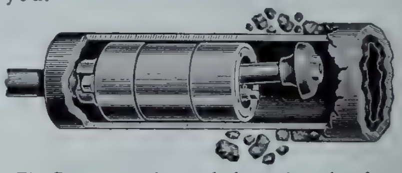
Write to-day for "Scale Removal Made Easy" and our free trial offer.



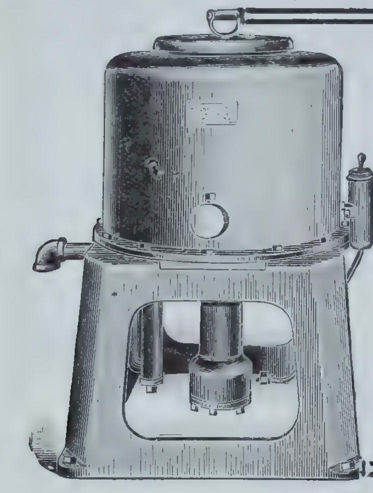
The Dean removing scale from the tube of a water tube boiler.

THE WM. B. PIERCE CO.

330 Washington Street, Buffalo, N.Y.



The Dean removing scale from the tube of a return tubular boiler.



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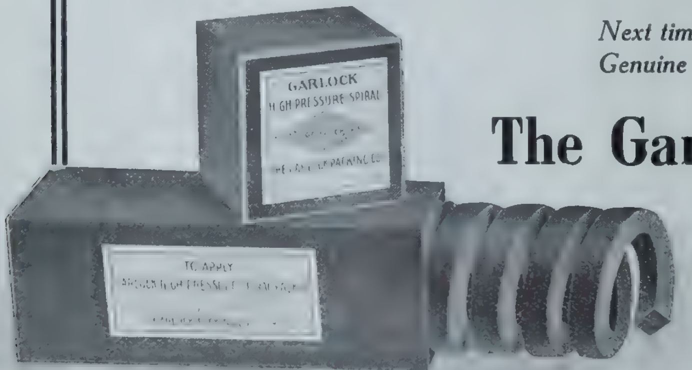

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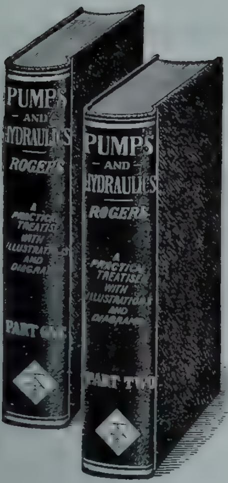
Hamilton, - Ontario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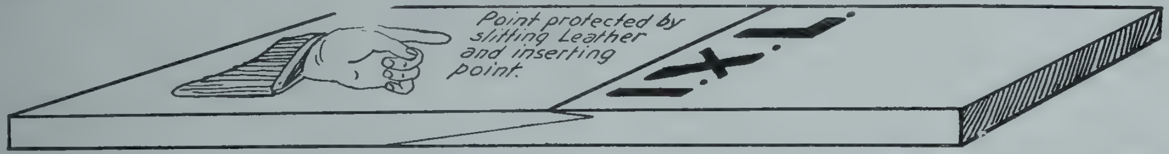
"THE BELTING SPLICE THAT WILL NEVER COME OPEN"



The great trouble with *any* belting—no matter how good the leather—that is joined up with the ordinary splice, is the fact that the splices come open, causing loss and delay. J. D. McArthur's Leather Belting made with the "I.X.L." SPLICE, as shown in this cut, *cannot* come open at the splices. Note the protected point, outside point running same direction as pulley.

J. D. McArthur's Leather Belting is made from Prime British Oak-Tanned Leather, from Close-Trimmed Backs exclusively.

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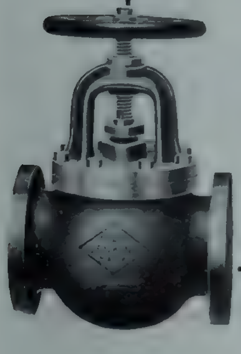

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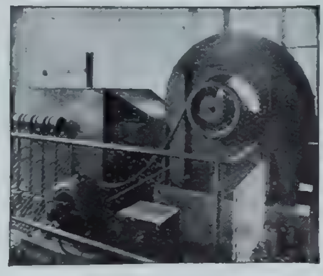

Cling-Surface is not a sticky dope to stop temporary belt trouble at the expense of worse trouble later on. It is a filler that penetrates into belts or ropes, making and keeping them pliable, clean, waterproof, preventing all drying out or cracking, and at the same time stopping all slip so that the rope or belt can be run easy or slack to transmit full load.

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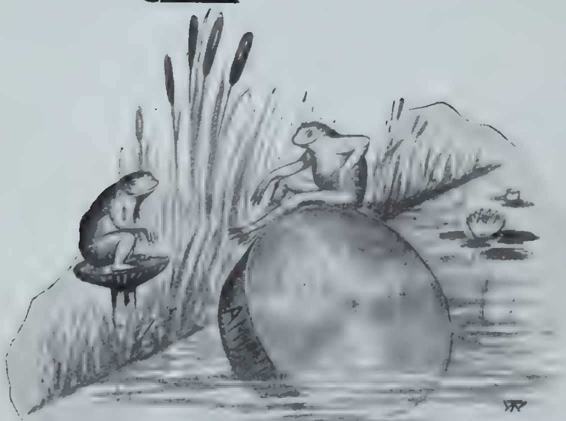

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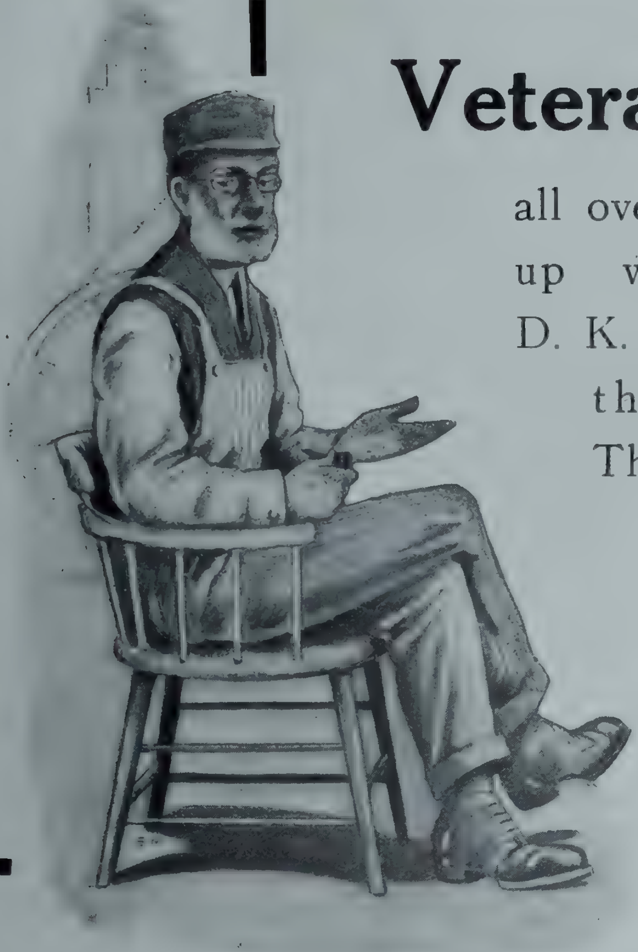

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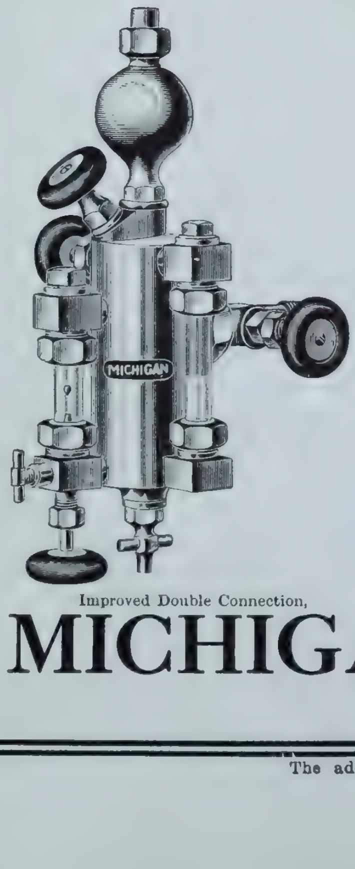

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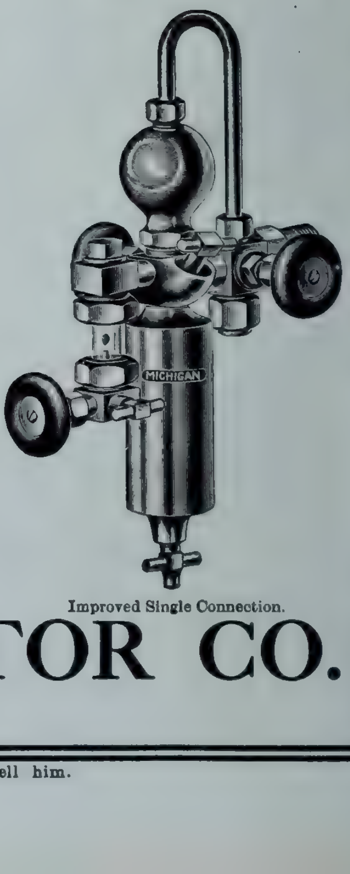

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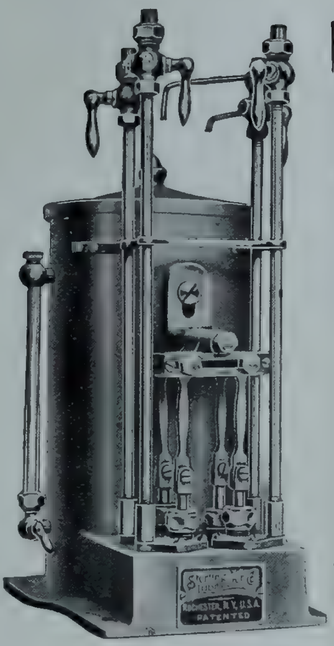

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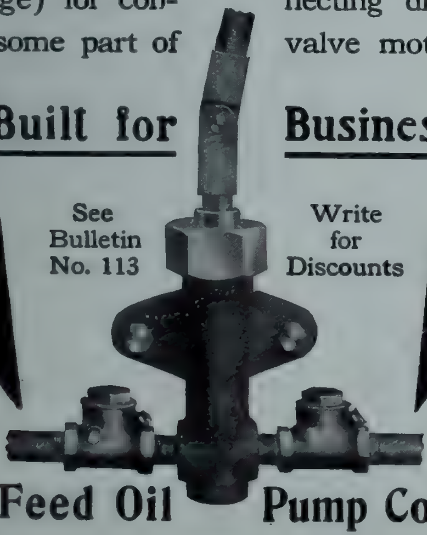

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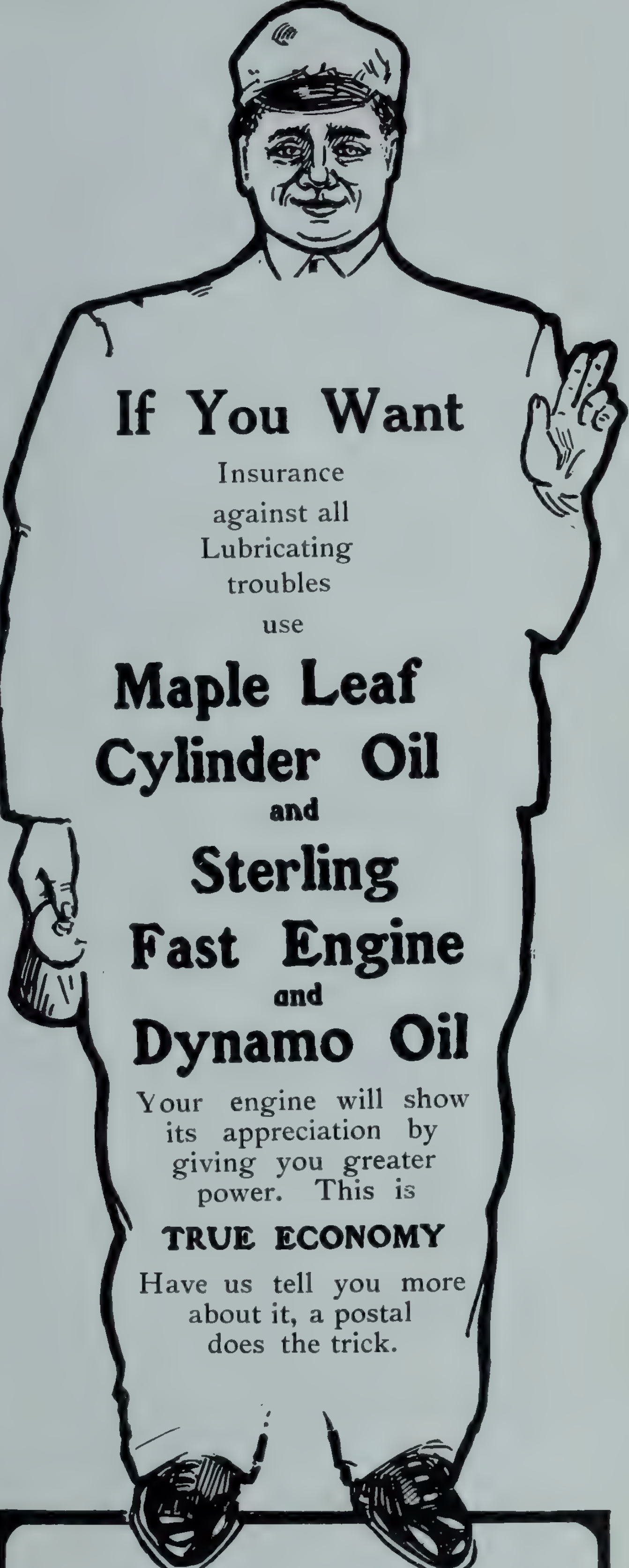

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Why not use a large part of this heat by installing a

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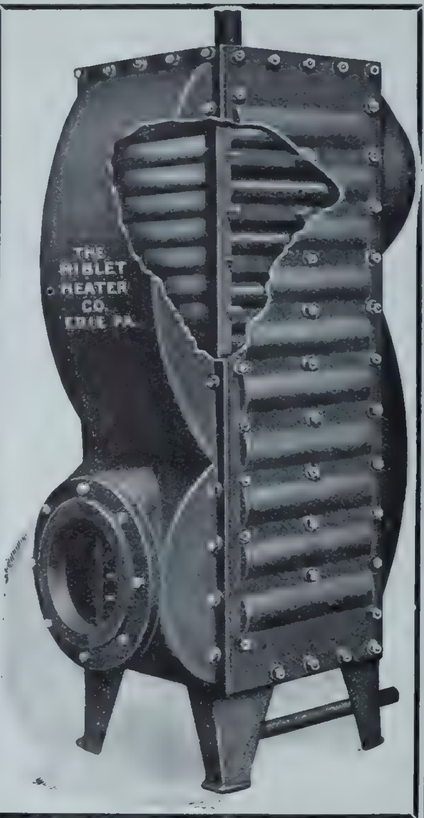

Here are a few features of the "Transverse" Heater

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¶ Water passages easily accessible for cleaning.

¶ No oil separator needed and can't possibly get out of order.

The heater will easily pay for itself in fuel-saving in a few weeks.

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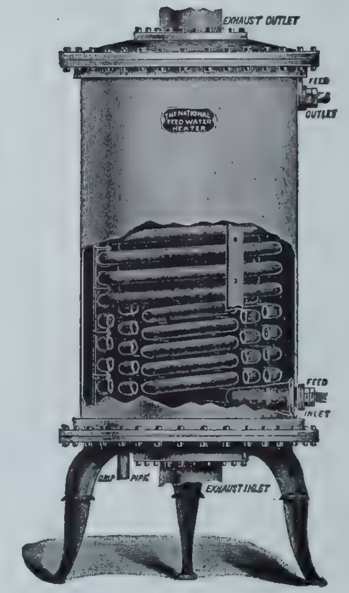

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From one to 14 coils of **seamless drawn** brass or copper tubing are encased in a **cast-iron** or **steel shell** to which **exhaust steam** is admitted, heating the water passing through the tubing.

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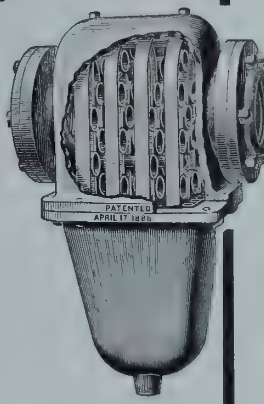

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This is

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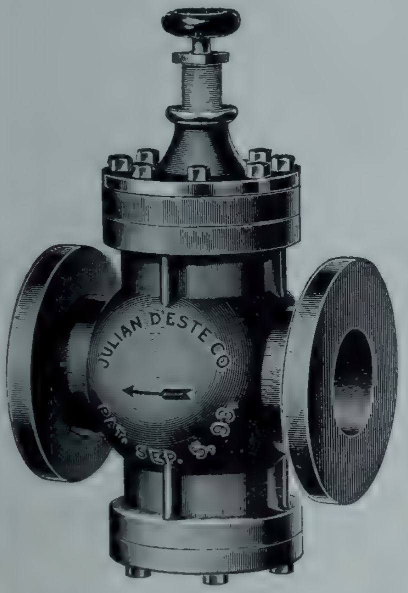

You can cut down pressure to any amount, and leave it so for any length of time with perfect safety by using the

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No Packing—No Glands—Simple—Strong—Sure

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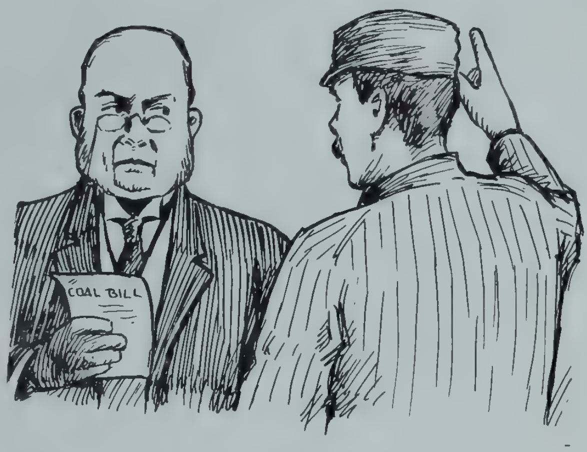
Steam wasted through Leaky Joints certainly does add to the coal bill

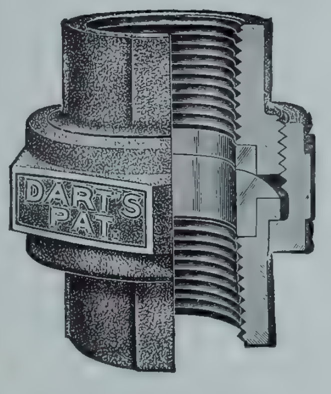


Every pound of steam that escapes through leaky joints means that a certain amount of coal has been burned to NO PURPOSE. Best way to avoid such waste is to use

Dart Unions

on all steam and compressed air pipe connections.

Dart Unions simply cannot leak. The Ball Joint formed by the two rustless, non-corroding, bronze-seated sections of the Dart Union makes a connection that is absolutely steam and air-tight. No packing whatever is required with the Dart Unions.



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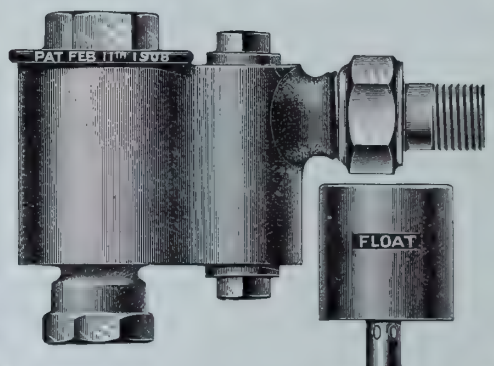

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Utilize your exhaust steam now going to waste

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That's what our **ECONOMIC VACUUM STEAM HEATING SYSTEM** will do for you

1. It makes for ECONOMY by eliminating BACK PRESSURE on engines supplying exhaust.
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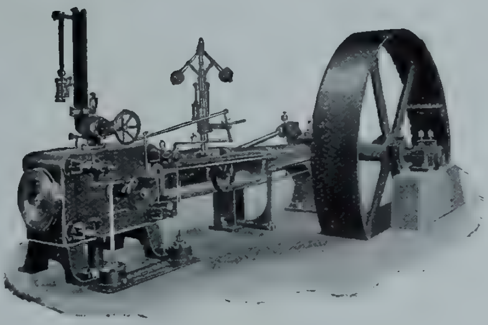
Girder or Heavy Duty Type Bed. High-pressure, Compound and Compound Condensing.



Our new valve-gearing permits of high speed and close regulation. Especially adapted to Direct-connected units.

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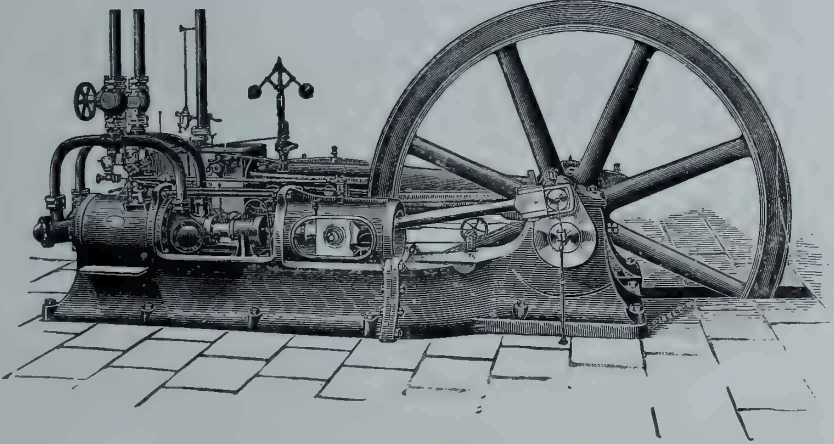

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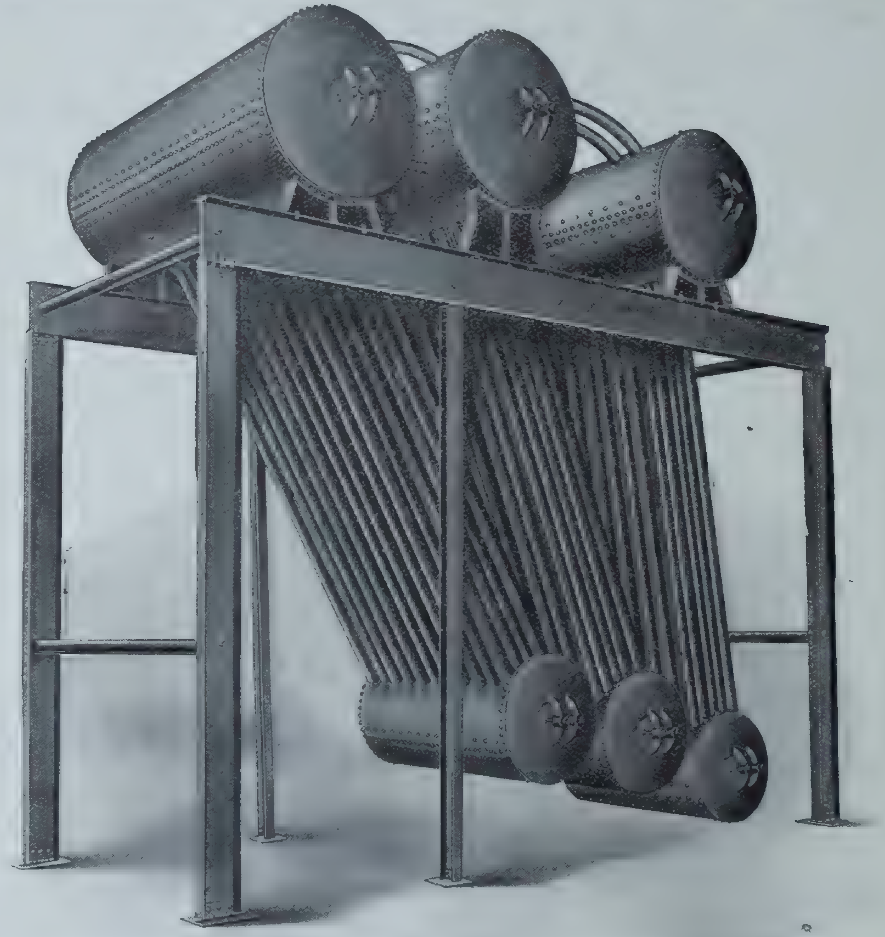

Side View of our NEW WATER TUBE BOILER. Not bricked in.

Our Engines, Boilers, Heaters, Pumps and Condensers are Prominent in Canada's Largest Power Houses.

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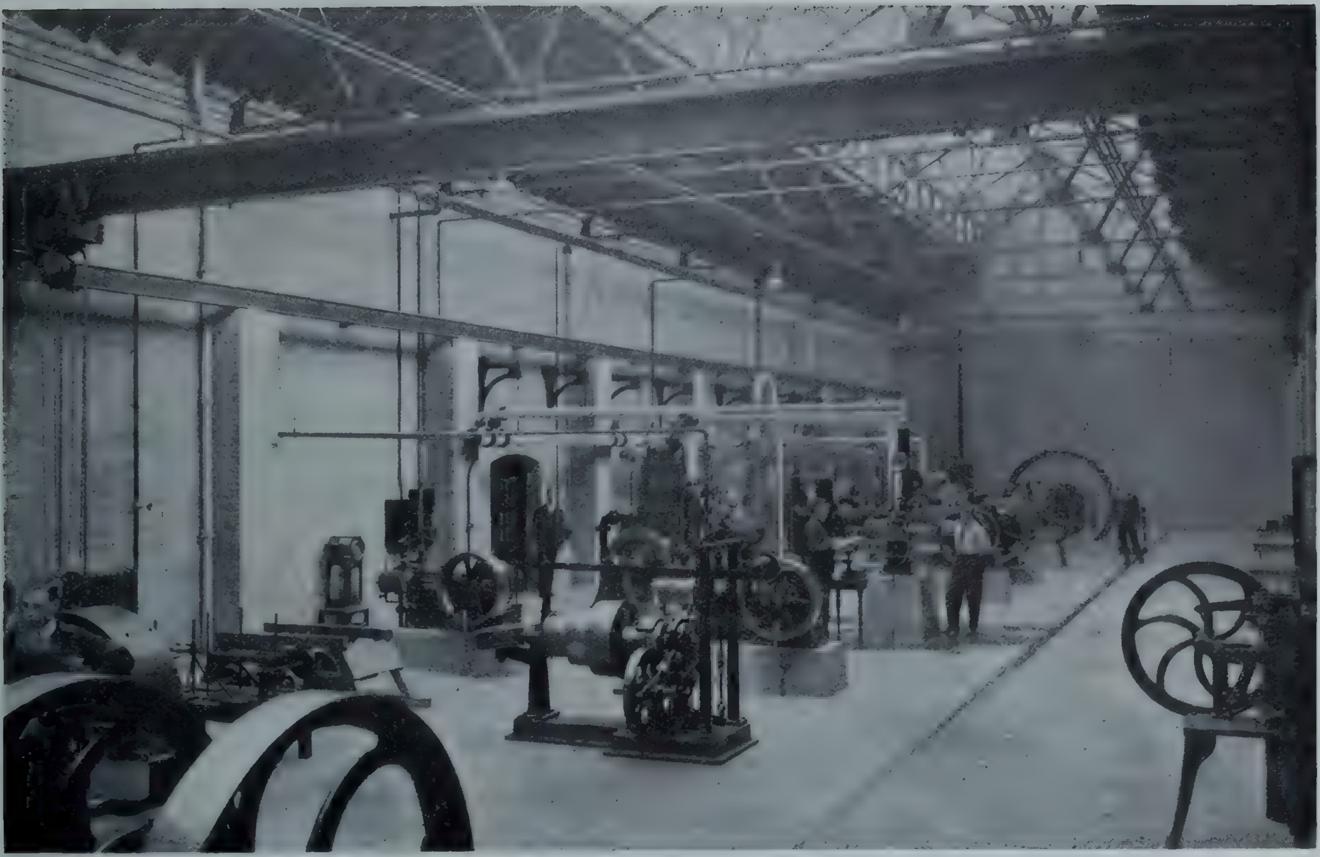


General View of Thermodynamic Laboratory, University of Toronto, from West End.

New Laboratories for Steam, Gas and Hydraulic Work

The New Laboratories of the University of Toronto, Showing the Layout of the Various Machines, etc., with Descriptions of the Equipment

The new laboratories of the University of Toronto contain machinery of interest to everyone with a taste for power equipment, whether for steam, gas or water power. In these laboratories, under the supervision of Robert W. Angus, Professor of Mechanical Engineering, valuable instruction is given in the subjects mentioned.

The line drawing shows the layout of laboratories. At the west end is the room devoted to gas engines, where there are gas, oil and other internal combustion engines. The equipment consists of a 10 h.p. engine built by Fielding & Platt, Gloucester, England; a 22 h.p. gas engine, built by the National Gas Engine Co., Ashton-under-Lyne, England; a Canada Foundry Co. producer gas producer; gas engine built by Otto Gas Engine Co., Philadelphia, and a marine gasolene engine, built by the Canadian Fairbanks Co., Toronto, to which will be attached an optical indicator made by Dobbie, McInnes & Co., Glasgow.

Other apparatus consists of a slide valve model and a journal oil tester, built by Riehle Bros., Philadelphia.

Steam Engines.

There are two small-size engines, presented by E. Leonard & Sons, London, for exercises and valve testing. Next to these is a 15 h.p. de Laval steam turbine, built by Greenwood & Batley, Leeds, England, and a 75 h.p. Williams engine. In the Williams engine the piston rods are hollow and the piston valves are operated by eccentrics forged solid to the crank-pin.

An 18 h.p. McEwen high speed horizontal engine is connected to the surface condenser. A Leonard-Boll engine develops 29 h.p. Next to this engine is an air compressor, built by the Canadian Rand Co., Sherbrooke, P.Q. It has a rated capacity of 340 cubic feet free air per minute. By disconnecting the air cylinder, the whole may be run as a cross-compound steam engine. A 50 h.p. Brown automatic cut-off engine, built by the Polson's Iron Works, Toronto, also forms part of the equipment.

Piping is arranged so complete boiler and engine tests may be made with one 50 h.p. boiler, and the Brown engine. All engines are piped to run either condensing or non-condensing, two surface condensers with independent air pumps being installed for the former condition of operation. A Cochrane feed water heater also forms part of the equipment.

Small Rooms.

The repair shop equipment consists of a 20 in. Bertram engine lathe, built by John Bertram & Sons, Dundas; a 20 in. McDougall drill; emery wheel, woodturning lathe, with a good supply of tools. The shop is driven by a Westinghouse motor.

In another small room is the apparatus for testing power transmission and this includes a torsional dynamometer, made by J. Amsler-Laffon & Sohn, of Schaffhausen, Switzerland.

A fourth room contains a refrigerating machine of three tons capacity, built by the York Mfg. Co., York, Pa. It is of the ammonia compression type.

The next room is set apart for instruments, which are supplied to the students on the "check" system. If the instrument is returned in a damaged condition it is charged up against the student.

Hydraulic Laboratory.

The hydraulic laboratory occupies the north half of the building, and is located in the basement and ground floors, each of which is 40x113 feet. Light is supplied by windows, taking up three-quarters of the side of the building.

Beginning at the west end of the top floor the first machine is a centrifugal pump of special design. This pump was designed along theoretical lines. It is mounted on a weir tank so that the discharge may be very easily measured. The pump is driven by a variable speed motor by means of which the power put into the pump may be determined. Adjacent to this are two orifice tanks and a weir tank. Various sizes and shapes of orifices are inserted and operated under several heads.

The water is discharged through 6-in. pipes into the calibrating tanks below, of which there are six. These calibrating tanks are of some interest and have been designed so as to be entirely operated by the movement of a single lever. When the lever is put in one extreme position one tank is made to fill, its outlet valve being closed, while the outlet valve of the other tank is at the same time open.

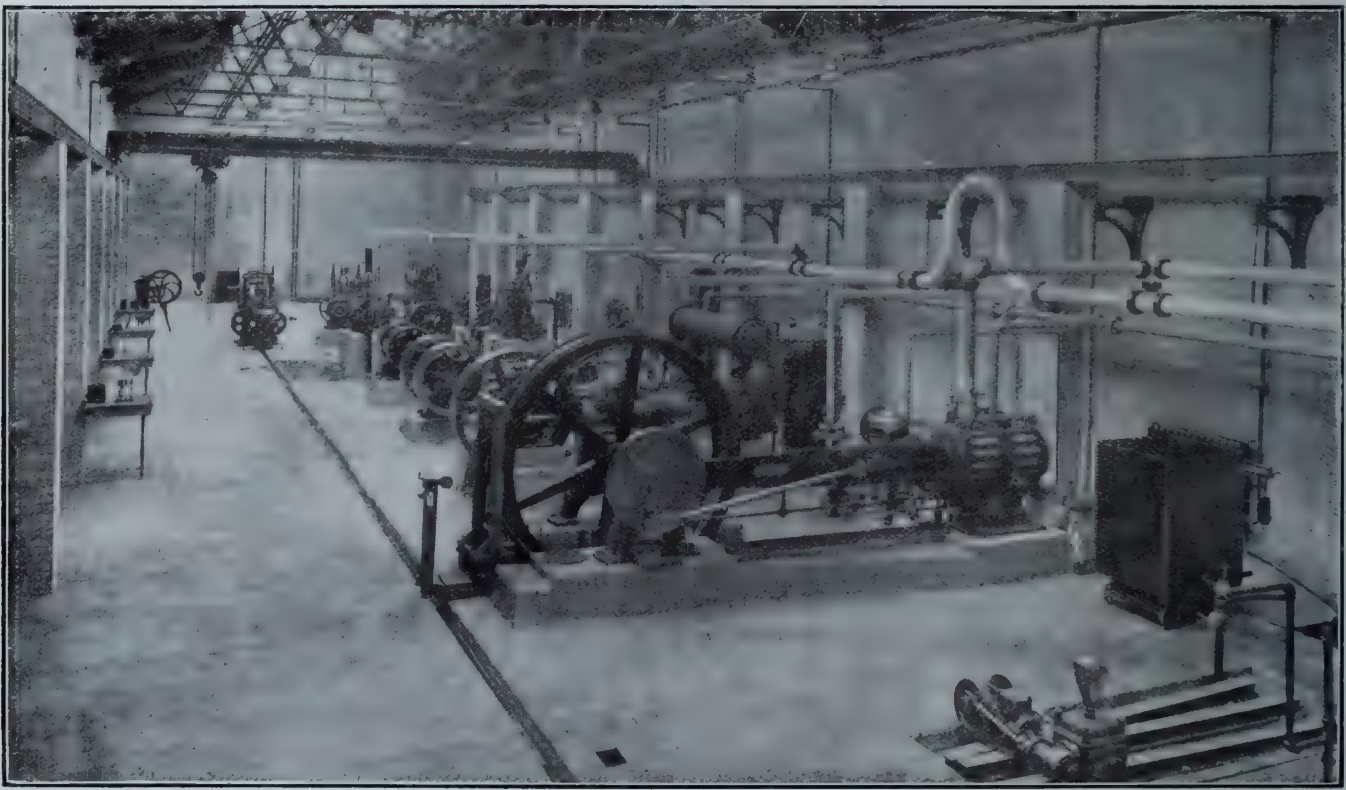
In order that experiments on these tanks and orifices may be carried on without interfering with the other work, a large reservoir, provided with an overflow, has been placed above them, and from this they draw water. From this reservoir a 1¼-inch pipe is also run to a hydraulic ram, which can thus be operated under a head of about 10 feet. A 3-inch Venturi meter has been installed on a pipe in which other meters will also be placed.

A little to the east of the centre of the laboratory an elevated platform has been erected for the impulse turbines. At present two turbines are in use, one a Doble wheel made by the John McDougall Caledonian Iron Works, Montreal. The other machine is an 18-in. wheel made by the Pelton Water Wheel Co.

At the east end of the room is a large stand-pipe 32 feet high and 5½ feet diameter, supported on a stand in the basement so that it reaches up into the roof of the building. This standpipe is used as a reservoir for the reaction turbines and also for any experiments requiring constant but not very high heads.

In front of this stand-pipe is a large weir tank 20 feet long by 6 feet wide, which is arranged with a sharp crested weir 4½ feet wide, with end contractions. This plate may, however, be changed so that weirs of different size may be inserted. The weirs used in this tank may also be calibrated by means of a pair of measuring tanks in the basement, each holding approximately 240 cubic feet, and both being connected to the weir tank on the downstream side of the weir by 12-in. galvanized iron pipes. Hydraulically operated valves are to be used in connection with these calibrating tanks and are so designed that a single lever is made to do the whole operation of filling and emptying, as in the case of the smaller tanks already described.

There are three reaction turbines available for testing. The smallest one was made by Wm. Kennedy & Sons, Owen Sound, Ont. The horse-power is measured by Prony brake and the discharge is determined from the 4½-ft. weir. A 9-in. McCormick turbine with cylinder gate forms part of the equipment.



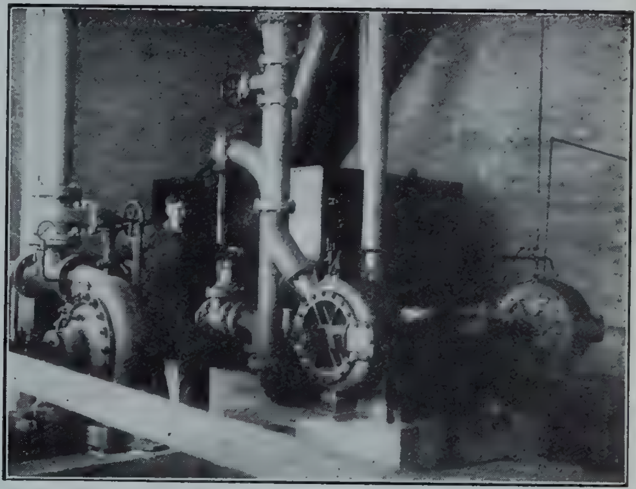
General View From East End.

The latest turbine installed is one from Escher, Wyss & Co., Zurich, Switzerland. This wheel, of the horizontal Francis type, has a well designed spiral casing and a runner nearly 14 in. dia. The gates are of standard design, operated through a ring by a hand wheel on the casing. A conical draft tube over 7 ft. long is used and the wheel will deliver 10 h.p. when supplied with 6 cu. ft. of water per sec. at a head of 20 ft.

Along the north side arrangements are

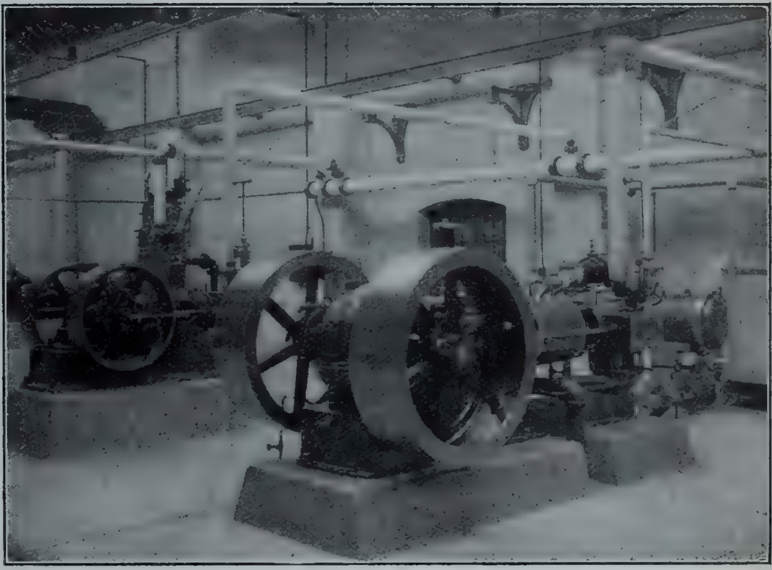
THE POWER HOUSE

View Showing Two Boilers and Two Stacks.

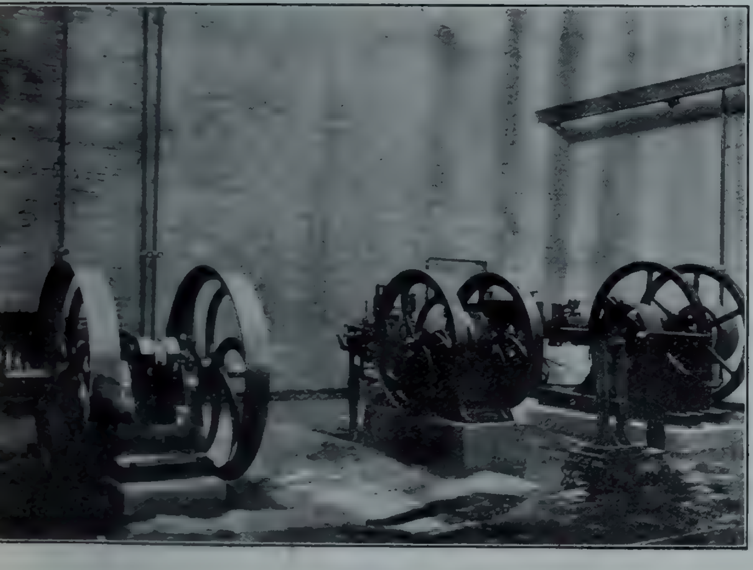


The Two Pumping Units.

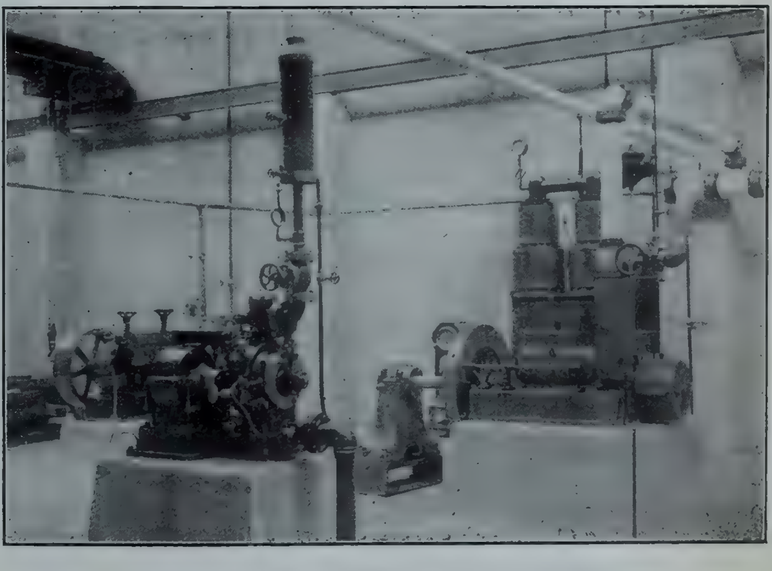
Refrigerating Machine.



Tandem and High Speed Engines.



The Gas Engines.



Steam Turbine and Willans Engine.

made for the testing of the friction in fire hose and iron pipe. A 2½ in. iron pipe 50 ft. long has been set up, also a 50 ft. length of fire hose, and the frictional losses are determined. The flow in the iron pipe is also studied by the Pitot tube.

The basement contains, in addition to the orifice and weir calibrating tanks already mentioned, the well and pumping plant. All water used in the laboratory is drained back to a large well from which it is pumped into the system and used over and over again.

There are two sets of turbine pumps used for this purpose, one of which was built by Gwynne, London, England, and the other by Escher, Wyss & Co., Zurich. Each set consists of two two-stage pumps fastened to a common bed plate and driven by a single pulley, couplings being arranged so that either pump may be separately operated. Further, the two pumps on the one base are piped together in such a way that they may be made to deliver into the piping in three ways, viz. (a) separately, (b) in series, (c) in parallel. A connection is also designed to connect the discharge from the Gwynne pump to the suction from the Escher-Wyss pump, putting the two sets in series for very high pressure work.

As suitable piping has been arranged in the laboratory, it may thus be seen that the whole arrangement of the plant is very flexible, permitting (a) the operaof the four pumps separately, thus allowing four absolutely independent experiments at one time; (b) the operation of the two sets separately on separate experiments; (c) the operation of the two sets in series for high pressures and moderate discharges as are required in fire streams and impulse turbines, giving 1 cu. ft. per sec. at 500 ft. head; (d) the operation of the two sets in parallel giving about 6 cu. ft. per sec. at the heads available in reaction turbine work in the laboratory.

The pumps are of modern design. They run at speeds of 1,300 and 1,400 revs. per min. respectively, and are belt-driven from a jack shaft placed on the floor. The jack shaft is driven by a Bellis Morcom engine of 130 h.p. running at 530 revs. per min.

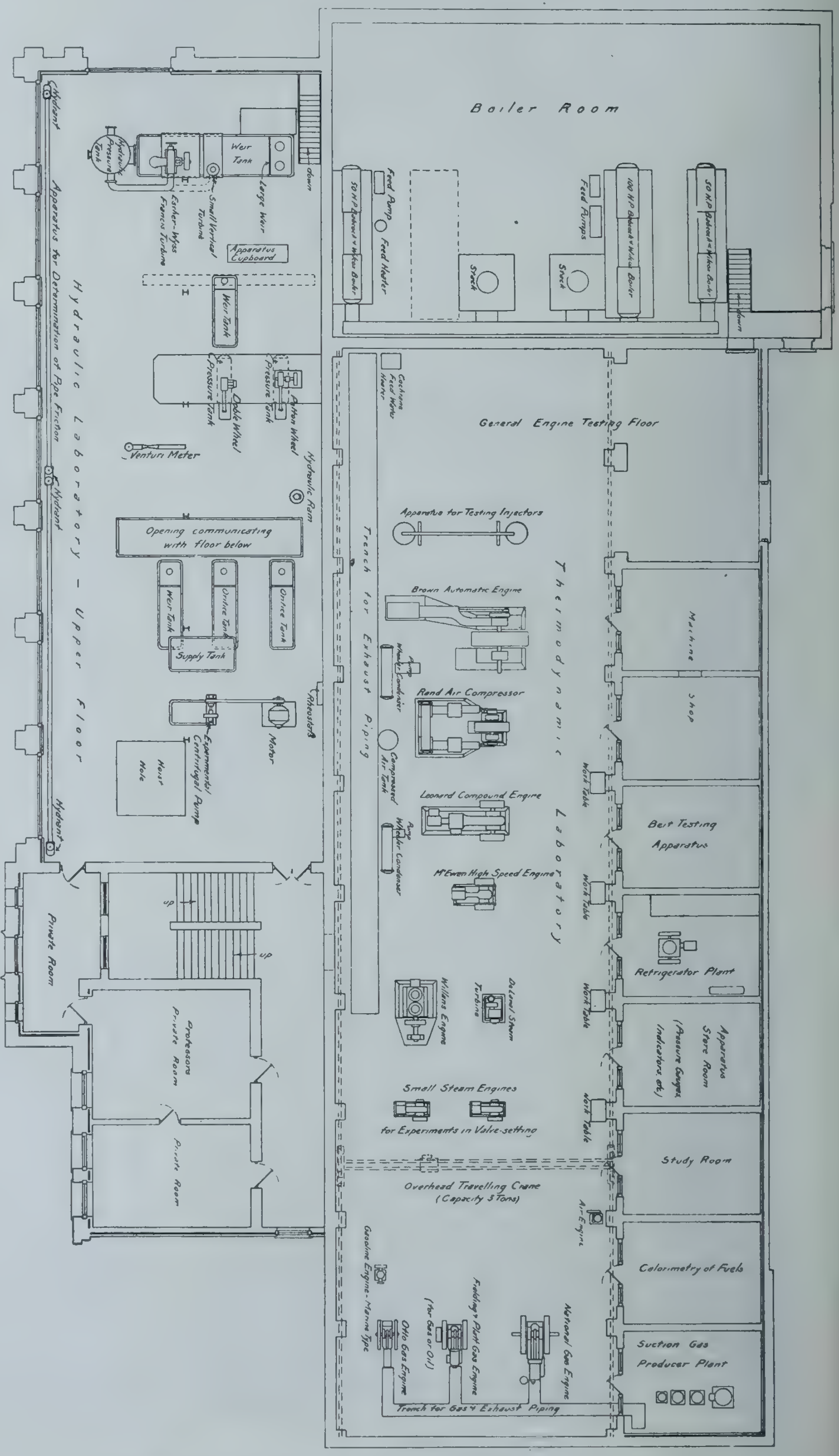
The boiler room contains three Babcock and Wilcox boilers, all built for 200 pds. pressure. The 100 h.p. boiler is provided with a superheater while the two 50 h.p. boilers have been set up independently and one is arranged with a special type of setting so that valuable comparative results may be obtained. A separate feed pump is provided for each boiler.

A steel breeching conducts the products of combustion to the stacks, of which there are two of brick, each 100 ft. high and 36 in. internal diameter. An arrangement of dampers allows these stacks to be operated at different powers on the same day.

Artificial Lighting.

The large Thermodynamic Laboratory is lighted by ten Nernst lamps, which are attached to the trusses and provide sufficiently good light to do any work required. The Hydraulic Laboratory is lighted by tungsten lamps, there being ten to each floor.

The remainder of the building, with the exception of the boiler room, which also has a Nernst lamp as well as incandescent lamps, is lighted entirely by incandescent lamps.



Boiler Room. Thermodynamic Laboratory and Top Floor of Hydraulic Laboratory.

Tests Show Fuel Saved by Fisher Fuel Economizer

The Results Obtained on Locomotives under the Supervision of Railroad Master Mechanics—Those Obtained in Stationary Engine Plants.

During the past two months many thorough tests of "Fisher Fuel Economizer" have been made, the results of which are of special interest to readers of The Power House for the following reasons :

1. A great saving in fuel is shown in each case.
2. Smoke abatement is secured and
3. In the case of locomotives, flying cinders and sparks from stack are practically eliminated, even on the fastest passenger trains.

The following are extracts from reports made by Master Mechanics having charge of the practical testing of the compound.

"On passenger run of 178 miles with train of three coaches, engine was furnished with 10 tons of untreated Inverness coal, consuming 8½ tons on trip, having to clean fire once en route, arriving one hour late. Cinders weighed at destination 1,376 lbs.

"On the same run, conditions being identical, with same engine, engineer and fireman, train of four coaches made trip with coal treated with Fisher Fuel Economizer, using seven tons of the same coal, without having to clean fire, and arriving at destination on time. Cinders weighed 313 lbs."

The same Master Mechanic made a comparative test with two tubular boilers in the shops of the company. These are the results :

With untreated coal.

Time	Steam Guage	Water glass.
7 A.M.	65	1-2
7.30	75	1-2
8	67	2-3
8.30	60	2-3
9	65	2-3
9.30	65	1-2
10	50	1-2

Amount of coal used 2,420 lbs. ; clinkers, 320 lbs. ; ashes, 140 lbs. ; total 460 lbs.

With treated coal.

1 P.M.	80	2-3
1.30	70	1-2
2	70	1-2
2.30	65	2-3
3	60	1-2
3.30	60	1-2
3.50	60	1-2

Amount of coal used 1,936 lbs. ; clinkers, 152 lb. ; ashes 108 lbs. ; total 260 lbs.

"On fast passenger run of 116 miles, with five coaches, 247 tons, weather very cold and heavy head wind, arrived destination on time, consuming 6 tons of coal treated with Fisher Fuel Economizer. Ashes in pan on arrival 8 bushels.

"The running time of this train is 3 hours and 15 minutes with 21 intermediate stops.

"On return trip with ten coaches, 494 tons, made schedule time of 3 hours and 25 minutes although detained 24 minutes on road from various causes. Amount of coal consumed 6 tons, ashes in pan on arrival 15 bushels. This consumption of coal includes at least 3-4 ton while engine was in round house, 10 hours 53 minutes.

"Ton miles 56,316. Pounds of coal to the unit mile 213.

"On up trip engine steamed very freely and maintained boiler pressure over division. Fire burned with a white heat and no smoke at stack. Average shovels to a fire 3, about 50 lbs., and although we increased a few times to six shovels to a fire, the smoke at stack was a light brown which cleared away quickly. Rake was passed over fire 3 times and did not produce smoke ; grates did not require moving. Coal was fair but had some slack.

"On down trip engine steamed free but varied slightly, fire burning with a white heat and no smoke at stack. Average shovels to a fire 3, about 50 lbs. Rake was passed over fire 5 times and did not produce smoke. Grates were shaken 3 times lightly. Coal was good but had considerable slack. Engineers and firemen were much cleaner on arrival than they are generally. No sparks could be detected coming from smoke stack and tubes and sheets in firebox had a clean appearance at the end of both trips."

On another fast passenger run of 110 miles the Master Mechanic reports that "engine steamed better with the treated coal than on previous trips with the same quality of coal not treated and although detained en route 16 minutes, arrived at destination on time using 1,300 lbs. less coal than usual. The same Master Mechanic on another trip over the same division during the heaviest snowstorm of the winter reports "Engine steamed good although air spaces in ashpan were plugged up with snow. Average steam pressure for trip was about 190 lbs. which I consider was good with the heavy snowfall, drifting very hard and no snow plow ahead. On arrival at destination had fire cleaned and ashes measured and got about 14 bushels of cinders and practically no clinkers. On return trip with untreated coal engine dropped back in steam to 170 lbs"

Probably the most severe test to which this compound was put in railroad service is covered by the following extracts from the report of still another Master Mechanic.

"Our train consisted of 46 loaded freight cars and one van, equivalent to tonnage of 1567 tons. My observation in reference to the fuel burning was that fire appeared to have a much whiter and yellow color than usual and also did not appear to throw sparks from stack. It was unnecessary to shake the fire or poke it half as much as usual and when I examined the ashes taken from the ashpan there was only about half the amount usually taken from one of these engines. On this trip we consumed the 11 tons of coal, which is the usual amount this engine burns, but one advantage over previous trips was that it hauled about 150 tons more, therefore the saving would be in the handling of a heavier train, thus doing more per pounds of coal consumed. The engine steamed better than usual but it is by no means a good steamer. It burnt the fire well and always seemed to be very hot."

Tests in Winnipeg.

The Royal Crown Soap Works, of Winnipeg, made a test covering four days using three of their four 80 h.p. return tubular boilers during the week ending Feb. 5. The fourth boiler was started on Feb. 3 at 1 p.m. thus making 2½ days for the four boilers. The coal used was 10,800, 11,035, 9,800 and 10,042, a total of 41,683 lbs. Steam pressures were 50, 50, 85 and 60.

For 4 days ending Feb 12, tests were also made with similar results Then the coal was treated and the following results obtained.

	steam.	cu. ft. water.	lbs. steam.	coal.	actual evap.	evap. f.& at 221 deg.
14	100	1288	84074	10069	8.30	9.01
15	105	1154	70129	8501	8.25	8.95
16	105	1259	76509	9543	8.02	8.70
17	101	1321	80277	9778	8.21	8.91
18	103	1403	85260	9843	8.66	9.39

The clinkers amounted on 3 boilers to 20 lbs. on 14th up to 1 p.m. ; 50 lbs. on 15 ; 30 on 16, 40 on 17 and 7 on 18 with a little better coal. This is a reduction of 30 p.c. of the ash and clinkers.

Also there was no occasion to clean fires at any time and grates showed just as clear fire and bright red ashpit at 6 p.m. as at 7 a.m.

The estimated saving in fuel, increased steam, increased output, etc., is worth about 25 per cent. economy.

Other Tests.

At the Central Light, Heat & Power Co., Montreal, using pea anthracite coal with Fisher Fuel Economizer. An evaporation of 8.7 per lb. was obtained as against 7.2 without using the economizer, showing increased efficiency of 20 per cent.

The W. H. Storey Co., Ltd., Acton, Ont., manufacturer of gloves, mitts, etc., made a test which showed a sav- of 25 per cent fuel using Red Jacket coal. There was also little or no smoke.

The advantage of Fisher Fuel Economizer will be felt on steamship lines where space is a big factor as it will enable them to carry an increased tonnage of merchandise through the less amount of bunker space required. The smoke is also eliminated.

The full economizer is sprayed on soft coal. It will be seen from the tests here given that the following results have been obtained: less fuel consumed, less clinkers, less ashes, smoke is eliminated and greater evaporation per lb. of fuel. The results are remarkable, and the tests being carried on by mechanical men, may be thoroughly relied upon.

A Study of the Steam Boiler and Strength Formulae

Abstract of Address Given to the Hamilton Branch C. A. S. E., Giving Useful Information in Regard to Boiler Joints, Strength, Efficiency, Etc.

By Jas. Crombie *

In addressing this body of Stationary Engineers, I think you will agree with me when I state that the steam boiler is one of the most important parts of the power plant. I do not think that any part of the plant gives the engineer so much concern as the boiler, especially is this the case when the boiler has been purchased second-hand, and no one knows its age, or what defects the paint may hide.

It is a great pity that the question of cheapness should enter so largely into this matter, when a manufacturer is buying a steam generator. A boiler may be dear at any price; only a few days ago a well-known boiler inspector told me that he was called on to examine a boiler for a friend who required one. The boiler in question, which was lying nicely painted in a second-hand dealer's yard, was found on examination to be totally unfit for service, and should have been consigned to the scrap heap. The next time that this inspector passed the yard where this boiler had been on view, it was gone, someone had bought it, and it is no doubt now under steam, and may add another disaster to the large number we already have, and which are classed as "a mysterious occurrence," as the poor fellow in charge who could tell the true story is possibly killed.

Ontario has not got boiler laws. A boiler manufacturer can make any kind of scamped work, and ship it in here, and no one can stop them, and we cannot compete with them, as no self-respecting firm in this province would put their names to work of this kind.

The other provinces have gone ahead and left this one to follow in the rear, where she ought to have led. I trust that this, our reproach, will soon be taken from us and that early this year uniform boiler laws will be in force throughout the whole of our Dominion.

Explosions.

It may interest you to know something of the energy that is available in the event of an explosion.

lbs. per sq. in. Absolute pressure	Initial temperature Deg. Fah.	Total energy liberated on reduction to atmospheric pressure and 212 deg. Fah. in ft. lbs. by 1 lb. water, by 1 lb. steam	
50	281	2,550	68,164
75	307	4,816	90,739
100	327	6,885	106,673
150	358	10,536	129,004
200	381	14,153	145,121

or stating these facts in a way that will interest you more.

A Lancashire boiler 27 feet long, 7 ft. diameter at 100 lbs. working pressure would have an available energy of 93,000-foot tons of water, and 2,351-foot tons steam. If the boiler went up it would rise to a height of 7,627 ft. equal to the explosive energy of 795 lbs. gunpowder, or a Lancashire boiler, 30 ft. x 8 ft. diam. at 150 lbs. w.p. would rise to a height of 8,473 ft., equal to 1,730 lbs. gunpowder.

A marine boiler 15 ft. x 13 ft. at 150 lbs. w.p. would be projected to a height of 7,581 ft., equal to the explosive energy of 2,464 lbs. of gunpowder. A plain tubular of 60 h.p. would rise to a height of 5,372 ft. A water tube boiler of 250 h.p. would rise 5,130 ft.

I have mentioned these things so that you will have some idea of the havoc that would be created should your boiler take a notion to go skyward. It is necessary, therefore, that you should understand in some measure something of the strength of the steam generator with which you are daily in contact.

At the convention of the Int. Master Boiler Makers' Association, held this year in Louisville, Ky., the fact was brought out that in the United States and adjacent parts of Canada the average boiler explosions were about 300 per year, for the past 20 years.

In Germany, where nearly the same number of boilers are in use, they have an average of 7 explosions per year. In that country they have laws that cover every boiler that is used. No matter for what purpose or where situated, it must be inspected.

From the pages of "The Locomotive" for the past 41 years, there have been in the United States and adjacent parts of Canada no less than 10,051 explosions, resulting in the death of 10,882 persons, or a total of dead and injured of 26,518, and this does not include the present year.

The year which is just closing has the largest loss of property, through explosions, of any year that we know of. In October three water tube boilers in Milwaukee, Wis., went up, causing a property loss of over $100,000.00, and loss of business of $300,000. (These boilers were in a brewery, and your sympathies will not go out to them, as I believe they would do were the same damage to occur to an engineering concern). When you consider the foregoing statements you will readily asknowledge that it is up to the engineer to look out for signs of decay in the boiler, to examine the interior surfaces for cracks, pitting or grooving. All braces should carefully examined, and any defects reported at once.

One very frequent cause of failure in boilers is the lap joint. This form of joint is being rapidly displaced, and butt joints with cover plates, both inside and outside, are now used.

Boiler Joint.

The lap joint has still a large field of usefulness in the smaller class of boilers, and in small locomotive type boilers for use in sawmill and mining and road and field work. In these boilers the lap joint is extensively used and will make nearly as good a joint as some of the butt joints, with a narrow strap outside and wide strap inside. This form of butt joint has the same bending action on the shell plate as the lap joint though not to the same extent, but there is this fact to be noted, that the lap joint will be treated with suspicion and carefully looked after, and this butt joint will be trusted because it shows a much higher efficiency, an efficiency that it does not deserve, and it will not be looked after as carefully. If cracks should develop they are hidden from the outside of the boiler by the brickwork casing, and cannot be seen from the inside, owing to the wide strap, the fracture usually occurring along the outer row of rivets in the shell plate. The best form of joint is the butt joint with outside and inside cover plates of the same width, having double, triple or quadruple riveting according to the size of boiler and the working pressure required.

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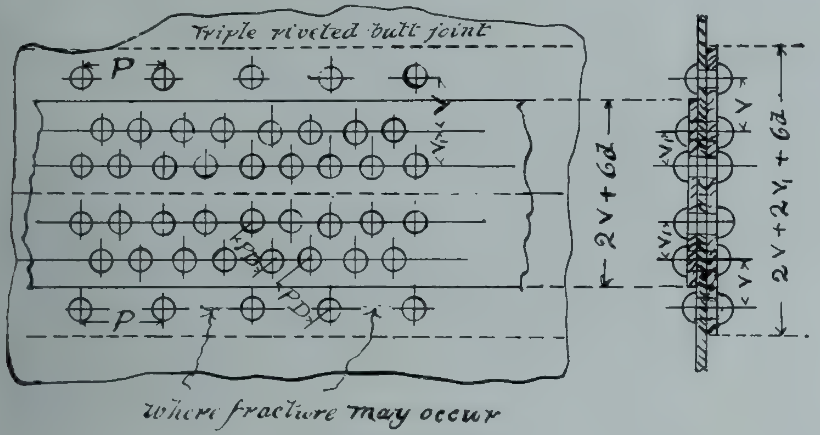
* Manager Boiler Department Sawyer & Massey Co., Hamilton.



Double and Triple Riveted Lap.

Working Pressure.

To find out the working pressure for the shell of the boiler the formula usually employed is

$$W.\ P.=\frac{T\ S\times t\times E}{R\times F}$$

Where—

W.P.=Maximum working pressure in pounds per sq. in.

T.S.=Tensile strength of plate in pounds per sq. in.

t.=Thickness of plate in inches.

E.=Efficiency of joint.

R.=Radius of boiler.

F.=Factor of safety.

Let us assume a small locomotive type boiler with a double lap joint with place 5-16 thick, that is t=.3125. T.S.=60,000 pounds. R.=15''. F.=5.5 then

$$W.P.=\frac{60{,}000\times.3125\times E}{15\times5.5}=X.$$

We must now find the value of E.

There is a limiting formula which will give us the maximum pitch of rivets in our joints.

Pitch=(C×t) +1⅝;

Where C is a constant=

2.62 for 2 rivets in lap joint.

3.47 for 3 rivets in lap joint.

As we are using a double lap joint we will have 2 rivets, and the constant will be 2.62, then pitch=(2.62×.3125)+1⅝=2.44'' pitch.

Then to find the efficiency of this joint of 2.44 pitch, and using 11-16 rivets in ¾'' holes we have

For plate between the rivet holes Ks=

$$\frac{P-R}{P}=$$

$$\frac{2.44-.75}{2.44}=67\%\text{off.}$$

We have also to find out the value of the rivet section, and we have for shearing on the rivets.

$$Ks=\frac{nsa}{P\times t\times TS}=\%$$ where n=number of rivets, S=shearing strength of steel rivets in single shear=42,000 lbs., and a=area of rivet, hole=.4418, P=pitch, t=thickness, TS=tensile strength of plate.

$$Ks=\frac{2\times42{,}000\times.4418}{2.44\times.3125\times60{,}000}=\frac{36227.6}{45.750}=79\%$$

efficiency.

Plate section then=67%, and rivet section=79%. The lowest value is 67%, and this is the value required to complete our formula

$$W.P.=\frac{60{,}000\times.3125\times.67}{15\times5.5}=152\text{ pounds.}$$

We have used 5.5 as a factor of safety, but many of the insurance companies use 5, and this would give us a still greater pressure, namely 167 lbs. Suppose we use a triple lap joint, then pitch=(3.47×.3125)+1⅝=2.709''.

$$Kt=\frac{2.7-75}{2.7}=72\%,$$ substituting this value for E, and with a factor of safety of 5, we would get a working pressure on this boiler of 180 pounds per sq. in.

We will now take a tubular boiler of 60'' diameter, ⅜'' plate, and use double and triple rivetted butt joints, and find the allowable working pressure, where TS=55,000.

S shearing strength of steel rivets, 42,000 lbs.

S shearing strength of steel rivets in double shear, 1.80 of single shear, some authorities only all 1.75 instead of 1.80.

t=⅜''=.375''.

R=Diameter of rivet hole 13-16=.8125.

A=Area of rivet hole, .5185.

with double rivetted butt joint at 3½'' pitch.

$$Kt=\frac{3.5\times.8125}{3.5}=76\%.$$

$$Ks=\frac{.5185\times42{,}000\times2\times1.80}{3.5\times.375\times55{,}000}=1.08\%.$$

The lowest value is 76%, then WP=

$$\frac{55{,}000\times.375\times.76}{30\times5.5}=95.$$

Using plate, 60,000 pounds WP=

$$\frac{60{,}000\times.375\times.76}{30\times5.5}=$$

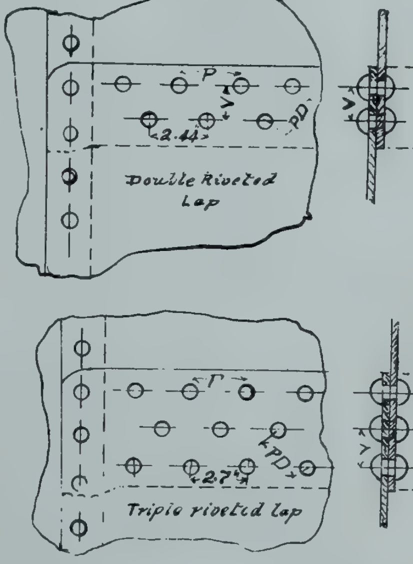
103.6 pounds working pressure.

Using a triple rivetted butt joint, pitch 6½ inches

$$Kt=\frac{6.5-.8125}{6.5}=.875\%.$$

for Ks we have the shearing strength of four rivets in double shear, plus the shearing strength of one rivet in single shear.

$$Ks=\frac{NSa+nsa}{P\times t\times TS}=$$



Triple Riveted Butt Joint.

$$\frac{4\times75{,}000\times.5185+(1\times42{,}000\times.5185)}{6.5\times.375\times60{,}000}$$

1.21%.

for Kst=strength of plate between rivet holes on second row plus shearing strength of (1) rivet in single shear in the outer row.

$$\text{Kst} = \frac{6.5-(2\times.8125)\times.375\times60{,}000 + (1\times42{,}000\times.5185)}{6.5\times.375\times60{,}000} = 89\%.$$

The lowest value is 87%, then

$$\text{WP} = \frac{60{,}000\times.375\times.87}{30\times5.5} = 112 \text{ pounds}$$

working pressure, using ½'' plate, then

$$\frac{60{,}000\times5\times.87}{30\times5.5} = 185 \text{ pounds working}$$

pressure, this is for a butt with two rows of rivets on outer strap, and three rows on inner strap, the chief reason for employing this strap is for the calking the rivets are pitched close along the outside edge and the plate will not spring as it would if the outer strap had the wide pitch.

We will turn for a few minutes to the end of our boiler, the formula for finding the area to be stayed above the tubes is

$$\times \times \frac{4H^2}{3}\sqrt{\frac{2\times R}{H}}-658=\text{area}$$

H = Height above tubes, minus 5 in.
R = Radius of boiler, minus 3 in.

The area so found is then the surface to be stayed, and is treated as a flat surface.

There are several rules for staying flat surfaces

$$\text{W.P.} = \frac{c\times T^2}{P^2}$$

Where—

T=thickness of plate in sixteenth of an inch.

P=Max. pitch of stays in inches.

C=112 for plates 7-16'' or under.

C=120 for plates over 7-16 inch.

another rule is $\frac{C\times(T+1)^2}{S-6}$=W.P.

T=Thickness of plates in sixteenths of an inch.

S=Surface supported in sq. inches.

C=A constant varying from 36 to 150 according to different methods of staying.

In closing I would refer for a short time to the constant for finding the maximum pitch of rivets, as we found in our lap joint.

You will remember that the pitch we found was 2.44 inches. Now the strange thing is that the smaller the rivet, the higher percentage of plate we have, us-

The electrical study is now bearing fruit.

$$\text{Kt} = \frac{P-R}{P} = \frac{2.44-11\text{-}16}{2.44} = .718\%.$$

$$\text{Kt} = \frac{2.44-\frac{3}{4}}{2.44} = 69\%.$$

$$\text{Kt} = \frac{2.44-13\text{-}16}{2.44} = 62\%.$$

We get 71% for 11-16 rivets, and on using a 13-16 rivet we only get .62%, because we have taken ⅛ inch more metal from between our rivet holes. It is a pity that we could not have a maximum pitch for a certain size of rivet and plate thickness, and then on adding a larger size of rivet, to add this amount to the pitch, as for instance we have 2.44 for 11-16'' rivets, and the difference between 13-16'' and 11-16'' is ⅛'', adding this to our pitch, 2.44+.125=2.565, our new pitch, then

our joint would $=\text{Kt}=\frac{2.56-.8125}{2.56}=$ 68% and

$$\text{Ks} = \frac{2\times.5185\times42{,}000}{2.56\times.3125 \text{ c } 60{,}000} = .907\% \text{ off of}$$

rivet section.

We have now an efficiency for our joint of 68% and .90%, but we cannot make this change, but must abide by this present formula until we can get it changed.

There are other calculations in figuring out a joint, but those formulas will not interest you greatly as the joint is usually rivetted, and you are dealing with a finished boiler, but if necessary to find the diagonal pitch, 3-10 P+D= diagonal pitch between outer and middle rows, and

$\frac{3P+4D}{10}$=diagonal pitch between inner and middle row and

$\sqrt{(11\text{-}20\ P+d)\ (1\text{-}20\ P+d)}$=V=distance between outer and middle row.

$\frac{\sqrt{(11\ P+8d)\ (P+8d)}}{20}$=V, distance between inner and middle row of rivets.

LIKES THE POWER HOUSE.

Norwich, Ont., Nov. 22, 1909.

To Editor, "The Power House,
Toronto, Ont."

Sir,—I have been a subscriber to "The Power House" since last August and will say it just fills the bill. I would not take for any one number the price I paid for subscription.

A. SMITH.

A NONCONDUCTOR.

The electrical study is now bearing fruit.

"Are you a conductor?" asked a lad of the collector of street car fares.

"I am," replied the courteous official.

"What is your name?"

"My name is Wood."

"Oh, that can't be," said the boy, "for wood is a nonconductor!"

ESTABLISHING CANADIAN OFFICE

Jens Orten Boving, London, England, has been in Canada for the past month in connection with Canadian business. His company has secured a number of large contracts in Canada and to facilitate the work, a Canadian company, under the name of the Canadian Boving Co., has been formed, which will act independently of the company in London. Mr. Boving is president of the new company; F. A. Yerbury, (Associate Mem. Inst, of C.E., (Eng.), is managing director, and J. A. Aeberli is chief hydraulic engineer.

The Canadian Boving Co. will carry on the work of water power engineers. Among the work they will undertake will be the hydraulic work of water power plants, centrifugal pump instalations, high and low-lift pump instalations, etc., Also, they have been appointed sole agents for the English Diesel gas engine. Another special line will be Boving electric furnaces for smelting ore. Plants are now in successful operation in Sweden, and have been favorably commented upon by Eugene Haanel, Director of Mines, Ottawa. Factories for the manufacture of their lines are in England, and one in Sweden. They also have one in Scotland for the manufacture of pipe.

Among their Canadian contracts already undertaken are the municipal plant at Winnipeg, where five 5,300 h.p. and two 500 h.p. turbines will be installed, equipped with automatic governors complete; four 16,000,000 and four 13,500,000-gallon centrifugal pumps in Toronto; hydraulic work at Mines Power, Limited, Cobalt; two 3,750 h.p. and two 350 h.p. turbines for Calgary Power Transmission Co., Calgary; complete hydraulic equipment for Vancouver Island Power Co. to furnish power to Victoria from the Jordan river; and equipment for Esquimalt Water Power Co., who will furnish Victoria with its water supply.

Mr. Boving leaves on March 19 for London, Eng., and Mr. Yerbury, an engineer of wide experience, will be in charge of the work in Canada. Until their offices are ready in the Lumsden building, corner Yonge and Adeladie Streets, their temporary offices will be at the Queen's Hotel, Toronto.

History, Mechanism, and Care of Elevators

The Plunger Elevator, Dealing with its Instalation, Method of Counterbalancing, Construction, Repairs, etc.; Remedying Elevator Troubles.

By J. H. SHALES *

The use of the plunger elevator is becoming more general every year, but there are few people who understand the method by which it is worked ; and if informed that the long steel tube, which they see attached to the bottom of the elevator, which moves up with the car and apparently never reaches an end, goes as many feet in the ground as the height of the building, they generally assume that they are being told a fairy tale. Yet they must know that this long steel tube has to go somewhere when the elevator is at the bottom of the shaft, but it is hard for them to appreciate the fact that the tube or plunger sinks into a cylindrical bored cavity hundred of feet in the ground.

One man recently gave as his theory regarding the disappearance of the plunger that it was patterned after the mechanism of the telescope.

Twenty years ago the modern high speed plunger elevator of to-day, as built by the Standard Plunger Elevator Co., would have been considered an impossibility. For many years the plunger elevator was used in a primitive form in England, where it was always known as a safe and durable machine, even in its earliest type. It was also used in several cities in the United States in a primitive form, but in none of these cases was it developed to such an extent as would justify its use for high grade service. The modern development of the elevator was begun at the Worcester Polytechnic Institute at Worcester, Mass., and subsequently men who had carefully studied the subject became convinced that this type of elevator was capable of still greater development and largely increased utility, and, as a consequence, the Standard Plunger Elevator Co. was formed.

This company has improved the plunger elevator in design, workmanship, cylinder sinking apparatus and controlling mechanism. Fortunately, the Standard Plunger Elevator Co. was able to make many improvements by which the height of travel, which had before been considered the most serious obstacle in the use of the plunger elevator, became merely incidental.

These plunger elevators are operated by hydraulic power, water under pressure ; and in the case of large plants, this power is furnished from a tank system, using a limited supply of water continuously by pumping it over and over from one tank to another. This pumping is performed either by an automatically regulated steam or electric pump, and the more economical form of elevator employed, the less the cost of pumping ; hence the reduction in power expenses by the use of the type of elevator of the Standard plunger elevator, becomes an important factor. Wherever steam is available it is always employed for the pumping, as the exhaust from the steam pump can be utilized for heating the building in the cooler months of the year, thus rendering the expense of elevator power merely nominal at that time.

In the plunger elevator the car is operated from beneath by a moving column, or plunger, of steel, finished and polished to a uniform diameter, and of a length a little greater than the travel of the car. As previously mentioned this plunger is worked by hydraulic power ; that is, it is sustained and moved by water surrounding it, and confined within a steel cylinder, the length of which is slightly greater than that of the plunger itself. There is no strain on the material beyond that which is merely nominal, owing to the fact that the cylinder and plunger ate of great strength. The cylinder enclosing the plunger is absolutely tight, being closed at the bottom by a welded end, and carrying at the top a stuffing box with an improved packing, through which the smooth plunger passes. The plunger makes no contact with the cylinder, being surrounded by water at all times.

Instalation of a Plunger.

The instalation of a plunger elevator is most interesting, and a brief description of the work will prove of value to the layman as well as the mechanic and engineer. The first step is the sinking into the soil of a steel casing, or small steel caisson, which is of slightly larger diameter than the cylinder, to provide space for the reception of the cylinder itself. This caisson is sunk until solid rock is encountered, and from this point downward the rock is drilled by an improved apparatus without casing, as it is unnecessary in solid rock. In the work of sinking the cylinder there is absolutely no interference with the foundations of the building. When the hole prepared for the cylinder is completed, which must be perfectly true and plumb, the cylinder is adjusted, the plunger is placed within the cylinder, and the platform of the car is attached to it through a platen by means of a flanged joint on the plunger itself, which is also firmly keyed to the platform through the platen. A bolt or cable is also independently connected to the platform from the lower end of the plunger. It will thus be seen that the only working joint of this apparatus is at the packing in the stuffing box at the top of the cylinder, and no water passes above this lever. The operation of the elevator is extremely simple.

Operation.

Water under pressure passes into the cylinder entering it at the stuffing box, and passes around the plunger through the annular space between it and the cylinder exerting its pressure to lift the plunger and the car and sustain it solidly at all points. When the flow of water is stopped, the car remains stationary, and when the water is allowed to escape from the cylinder, the car decends. It will thus be seen that the car cannot fall, as the water cannot escape through the annular opening around the plunger and the stuffing box with a velocity sufficient to permit of a dangerous descent. If the cylinder should burst the car could not fall, because it would be impossible for the water to escape through the apparatus between the casing and the cylinder, which is closed at the top, with sufficient rapidity to produce such a result.

If the pipes supplying the water or the controlling valve itself were to burst, the car would be stopped in a perfectly normal manner at the lower landing by the automatic limitation stop valve directly at the cylinder. In fact, there is no possible condition which could cause a fall of the Standard plunger type elevator. The man in the car operates the elevator through the controlling valve, which permits water to enter the cylinder for ascent and leave it for descent, or confine it for a stop. This valve is certain in its operation, and it governs the flow of water in such a manner as to produce smoothness and freedom from vibration or bounding, at all speeds and at every change of motion.

Method of Counterbalancing.

There is no loss of power resulting from diminution of water pressure as the elevator ascends, or from the weight of the plunger itself. By a careful method of counterbalancing, accomplished by the water within the elevator cylinder, loss of power is done away with, while in addition a counterbalancing effect is secured in the ordinary manner by a counterbalance weight, which is attached to the car by cables, the com-

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* Consulting Engineer Elevator Specialty Co., Toronto.

bined weight of which, per foot, is exactly equal to one-half the loss of buoyancy in the plunger as it ascends. The counterbalancing arrangement equalizes the lifting capacity and speed of elevator travel at all times in a manner most simple and efficient. The cables employed are of great strength, but they are subject to only slight wear, and in the oldest plunger elevators in operation to-day it has never been found necessary to renew them.

Of course, in instaling these elevators to ascend nearly three hundred feet, as the Standard Plunger Elevator Co. is now doing, it is impossible to construct the plunger in one piece. It is made in sections of steel tubing, each section about twenty feet long, which are joined in a manner that secures an absolutely uniform column, with its strength in no way impaired at the point of junction.

To accomplish this, the Standard Co. have devised a special joint more than equal to the strength of the steel tubing composing the plunger, which is capable of resisting cross breaking or buckling. In the actual case of the company's elevators there has never been known a long plunger under load and in operation where any deflection of bending or buckling or deviation from the vertical has been noticeable to the eye. This shows that the material of the plunger is subject to strain only to the amount of a slight thrust, for a long plunger could be artificially deflected at its centre from the vertical to an extent suffiient to cause it to touch the side of an ordinary hatchway without subjecting the material to destructive stress.

Easy to Repair.

All working parts of the apparatus connected with the elevator are directly accessible ; should it be desired to renew a cylinder—which has never happened in the history of plunger elevators—such a cylinder could be easily removed from its casing and a new one substituted, as the cylinder is at the bottom of an open elevator well, with all necessary and convenient room above it for handling. This of course, is a great advantage over the old style elevator, where the apparatus is built into the building in such a way as to involve serious structural changes upon removal.

The maximum of economy of operation must result from the use of the plunger elevator, as it is only direct application of power for elevator purposes. There is no loss from friction of sheaves, cables, worm gears and the multiplicity of devices used in transmitting power in other forms of elevators. The cost of repairs on a plunger elevator is light. No part of the machinery is subject to severe strain or serious deterioration from wear, and plunger elevators of the primitive type, much inferior to the modern Standard plunger elevator, are running daily after constant use of over twenty-five years, thus establishing the long life of plunger elevators from actual experience. By actual tests, the plunger elevator shows great efficiency in raising weights.

Safety of the Plunger.

In order to obtain efficient and safe elevator service at landings, it is necessary that the elevator hoisting engine should be of the best and most positive type, and that the controlling apparatus should be certain in its operation under all conditions. The Standard plunger elevator is in this respect very simple, and its double ported controlling valve, with its differential safety pilot valve motion, gives excellent control. This controlling valve is positive in its operation, under all circumstances and conditions, whether the car be at rest or in motion, or at any speed, and the value of such service is readily appreciated in view of the many serious accidents which occur at landings.

This controlling apparatus is also of great value because it permits the operator to maintain absolutely a positive control as he leaves the landing or approaches it, thus facilitating the making of an accurate landing, in which the floor of the car shall be absolutely level with the landing itself, thus avoiding minor accidents due to the falling of passengers entering or leaving the car, and also the serious waste of time incident to the employment of inferior controlling mechanism. The absence of vibration and the positive control obtained by the plunger elevator give passengers a sense of security in high buildings.

In order to secure absolute safety at terminal landings it is important that the car be properly stopped at these points independent of the operator and the regular controlling mechanism, thus obviating the possibility of dangerous over-running. The automatic limitation stop valve of the Standard plunger elevator in connection with its lever shifting device, gives a safety at terminals more satisfactory than has hitherto been obtained. Buffers are also provided, thus limiting the travel of the car at terminals independent of any valves or any other mechanism. Thus it is seen that it is impossible for an accident to occur from overruning at the terminal landings.

The first requisite of elevator service is safety, and the most serious accident that may occur in the use of elevators is the falling of the car. It is safe to say that an elevator which has a plunger beneath to support it and cables above to counterbalance it, is free from the possibility of falling. The theory of the plunger elevator is a supported car, rather than a suspended car.

PHENOMENA OF HEAT.

By O. P. St. John.*

What is heat? Up to near the close of the eighteenth century, the generally accepted theory of heat was that it was "A subtle elastic fluid penetrating the pores or interstices of matter, in the same manner as water does a sponge." In other words, that heat was a material substance. This was called the "Materialistic" theory.

But there were some phenomena connected with heat, which could not be reconciled with this doctrine, and another theory was advanced, viz.: that "Heat was a commotion or agitation of the particle, or molecules of matter." This is called the "Kinetic theory."

Among the first to adopt this theory was Sir Humphry Davy, the inventor of the miners' safety lamp, which bears his name. Sir Humphry Davy made several experiments to prove that this view was correct. Among others, he took two thin slabs of ice, and in a room in which the temperature was at 29 F., or 3 degrees below the freezing point, he rubbed their flat surfaces together, with the result that in a short time the friction of the abrading surfaces had melted a portion of the ice, and the resulting water stood at a temperature of 35 F., or 3 degrees above the freezing point.

Now, it is a well-known fact, that a mass of water contains a greater amount of heat than an equal mass of ice, consequently it would be manifestly impossible for the ice to furnish a sufficient amount of heat to transform a portion of itself into water at a higher temperature than that of the original ice.

In an essay published by Sir Humphry Davy, in 1790, on "Heat, Light and Combinations of Light," he gave it as his opinion that, "Heat was the result of motion, and that the laws governing its transmission were precisely the same as those governing the transmission of motion."

About the same time, Count Rumford published a number of essays in support of the kinetic theory of heat. Count Rumford was an American, named Benjamin Thompson, who left America soon after the close of the Revolutionary war, and was employed by the Bavarian Government in scientific research, particularly in the line of explosives, and gunery. For his achievements in this direction he was created a Count, taking the name of Count Rumford.

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Count Rumford's attention was first called to this subject while he was in charge of the Bavarian arsenal at Munich, by the heat generated while boring out the cannon, and he made an exhaustive study of the question. He became involved in a discussion on the subject with several French and German scientists, and to prove to them the correctness of his views, he invited them to witness the following experiment.

The cannon made at the Munich arsenal were of bronze, and were cast on end, with muzzle end up. Extending above the muzzle was a solid piece of metal, called a "header," the object of which was by its weight to compress the metal in the body of the gun, forcing the bubbles of air and gas up into the header, which was cut off before the gun was bored out.

Count Rumford procured one of these guns and fixed it firmly in a rest with the header projecting through one side of a small tank. Projecting through the opposite side of the tank, he placed a blunt boring tool of hardened steel, 3½ inches in diameter. This boring tool was pressed against the muzzle of the gun by a screw, with an estimated pressure of 10,000 pounds. The mechanism for rotating the boring tool was operated by horses.

In the tank was placed a sufficient quantity of water at a temperature of 60 F., to cover both the header and the boring tool. In one hour after commencing operations the temperature of the water in the tank had risen to 107 degrees, in two hours it was at 187 degrees F., and at the end of two hours and a half the water began to boil vigorously.

The surprise of those who witnessed the experiment was very great, they could not understand how water could be made to boil without the application of heat from some independent source.

The result of this experiment completely refuted the "Materialistic" doctrine of heat, for as Count Rumford said, "Anything that an insulated body, or system of bodies, can continue to furnish without limitation, cannot possibly be a material substance."

It was not, however, until nearly fifty years later that the kinetic theory was generally accepted by scientists.

In 1840, Dr. Joule, an English gentleman, a scientist, and natural philosopher, who was a strong advocate of the kinetic theory, commenced a series of experiments, which lasted for nearly ten years.

Dr. Joule argued that if motion could be converted into heat, that heat could likewise be converted into motion, and his experiments were undertaken with a view to determining their relative value.

Heat Measurement.

The unit of motion had been determined by James Watt long before this time, as the "Foot-pound," or force necessary to raise one pound in weight, one foot high. It then became necessary to fix a unit for heat, and this was assumed to be the quantity of heat necessary to raise the temperature of one pound of water from 39 to 40 F., at which temperature water is at its greatest density. This quantity of heat is called the "British Thermal Unit" (Usually written B.T.U.) Dr. Joule found that the quantity of heat required to raise one pound of water from 60 F. to 61 F. was practically the same as from 39 to 40, and for greater convenience in experimentation, this is generally accepted as the unit of heat, and is written h.u.

The French unit of heat is called a "Calorie," and is equal to 3.968 B.t.u. This unit of heat is used where the metric system is in use.

Dr. Joule's experiements were undertaken to ascertain the exact value of a heat unit in foot-pounds, and for this purpose he took a small copper cylinder through the cover of which he introduces a spindle, the lower end of which ran in a "Step" in the bottom of the cylinder. Attached to this spindle inside of the cylinder were vanes, or paddles, and to the inner sides of the cylinder, vanes or screens were also attached, the object being that when the spindle was rotated, the water would be broken up into minute particles. To the upper end of the spindle was fixed a drum or spool around which was wound a cord, the free end of which was passed over a sheave, and having a weight attached to it, so that when the weight was released it would rotate the spindle. Passing through the cover of the cylinder at one side of the spindle was a very sensitive thermometer, graduated to one hundredths of a degrees, so that any change in the temperature of the water could be easily noted.

After carefully experimenting with this apparatus to determine the friction, one pound of water at a temperature of 60 degrees F. was placed in the cylinder, and it was found that a weight of 77.2 pounds falling through a distance of 10 feet was sufficient to raise the temperature of the water in the cylinder one degree. By this it was determined that the value of one thermal unit was equal to 772 foot-pounds. A number of experiments were made, all giving practically the same result.

Later experiments with more modern and delicate apparatus have shown that the mechanical efficiency of a heat unit is rather more than this, viz:—778 foot-pounds, but most of the text books give 772 foot-pounds as the heat equivalent. This is called "Joule's Equivalent," and by this we are enabled to make some very interesting calculations.

A familiar example of the conversion of heat into power is found in a locomotive drawing a railway train. The coal consumed in the furnace transmits a portion of its heat to the water in the boiler, converting it into steam. The steam being admitted to the cylinders, expends a portion of its heat in pushing the pistons to the end of their stroke, thus converting it into useful work in drawing the train. Approaching a station where it is desired to stop the train, the steam is shut off, and the brakes applied, when the stored up energy in the train is converted into heat, which may be seen in the sparks flying from the brakes, and felt in the heat of the brakes, wheels and rails.

As an example of the manner in which "Joule's Equivalent" enables us to determine the efficiency of an engine, or boiler, we will assume that a locomotive consumes 6 pounds of coal per indicated horse power, per hour and that each pound of coal consumed in the furnace has a heat value of 10,000 heat units, we have therefore 10,000×60 equals 60,000 heat units expended for each horse power of work done per hour.

A horse power is supposed to be 33,000 pounds lifted to a height of one foot, in one minute, or 33,000×60=1,980,000 foot-pounds per hour. Dividing 1,980,000 by 772 foot-pounds (the equivalent of one heat unit), gives us 2,567.2 as the heat-units converted into useful work. Then as 60,000 : : 2567.2 : : 100 : 4.27, or a little over 4¼ per cent. of the heat contained in the coal has been transformed into acutal work.

Again, supposing that the weight of the locomotive and train is 200 tons, or 400,000 pounds, and that at the time that the brakes are applied the train is moving at the rate of 500 feet per minute (a little less than 6 miles per hour), the stored up energy in the moving train would be 400,000×500 equals 200 million foot-pounds, dividing this by 772, we have as the heat equivalent 259,067.35 heat units, or sufficient to raise 1439.26 pounds of water from freezing to the boiling point.

From this illustration, we can form some idea of the enormous losses sustained by the railways in starting and stopping their trains.

Thus far we have dealt with heat, imparted to or abstracted from bodies as indicated by a rise or fall of the temperature of that body. This is called sensible heat; or heat which can be felt, but there are cases in which the temperature does not vary in a mass of matter, when heat is communicated to, or taken from it. For instance, when a body of ice is at the melting point, heat communicated to it does not raise the temperature above 32 degrees F., or if the body be water, at the boiling point, in the open air, heat slowly applied to it in however great a quantity, will not raise its temperature over 212 degrees F., at the normal atmospheric pressure of the atmosphere. This is called latent heat, or the heat absorbed or given off by a body in changing from a solid to a liquid, or a liquid to a gaseous state, or vice versa.

If a mass of ice be placed in an equal mass of water at a temperature of 176 F., it will be found that when the last particle of ice has just melted, the temperature of the water will be 33 F. Subtracting 33 from 176 leaves 143, and this is the latent heat of ice. In other words, a mass of water at the freezing point (32 degrees F.) gives off 143 heat units in changing from water to ice, although there is no decrease in the sensible temperature of the ice.

Again, a mass of water at the boiling point, in the open air, at the atmospheric pressure, at the sea level, will absorb 965.7 heat units in changing from water into steam, although the temperature of the steam will be no greater than that of the boiling water.

The study of the phenomena of heat is a very interesting subject. In the limited space, it is impossible to more than touch upon some of the more abstract principles of it, but it is so intimately connected with the science of steam engineering that every engineer should give it attention.

How to Secure the Smokeless Combustion of Coal

Second Article on Smoke Abatement—This one Deals with Draft and is Contributed by W. Norris, M.E,. Chatham, and Treats of Effect of Draft on Combustion.

In this time of keen competition in every line of business one of the chief objects is economy. To this end we find all manner of contrivances and schemes projected by scientific men.

But we must not be contented with the idea that such men are alone responsible for the proper solution of the problem because every man that has to deal with material which costs money is equally responsible and should use his brains while laboring with his hands, and right here the man burning coal under a steam boiler comes in for a very large share of this responsibility. One of his chief objects should be to gain a fair knowledge at least of the elements necessary to be combined to bring about the best results.

We will therefore deal with what we call draft, which subject we cannot exhaust in this paper but we will endeavor to impress a few facts in a simple manner that will be of some benefit to all who take the trouble to follow up the same.

Meaning of Draft.

Draft has a double meaning, generally draft is referred to as the difference in pressure of the air between the outside of a furnace and the gases as they leave the boiler.

Draft is also an expression of the volume or weight of the gases passing through the fire.

Pressure Gauge.

A very simple instrument for the measurement of the pressure conditions of the draft, consist of a glass tube bent in the form of a U, one leg of the U thus formed is left open to the atmosphere while the other end is connected in the draft passage.

This end if connected above or through the furnace doors, would indicate the pressure of the draft in the furnace, while if connected into the gas passage where the gases leave the boiler will give the pressure of the gases, providing that the boiler is close to the chimney, so that there is no friction to the gases between the boiler and the chimney.

Water is put into the U tube which, when both ends are open to the atmosphere, the water will be the same height in both legs, but as soon as one of the legs is connected into a gas passage the water will have a tendency to rise in one leg and lower in the other leg, thus proving that the gases in the passage is lighter than the air outside of the passage. Properly speaking it shows that there is a difference in density of the air outside and the heated gases inside which density is governed by the atmospheric pressure and the temperature of the gases which, is not the same in all locations or at all times.

The Atmosphere.

The atmosphere as we understand has different densities (or weight) per unit of volume, say per cubic foot, which is affected by the temperature of the air. We are told that there is atmospheric pressure 45 miles above the earth and that its density at sea level under standard conditions, that is, at a temperature of 32 degrees F., is equal to a pressure of 14.7 lbs. per sq. in. on a surface in a space where all the air would be removed as fast as it could rush or flow into that space; we would have then what is known as a perfect vacuum or a space from which all matter has been removed or using the usual definition a space void of all matter. This would be equal to a column of mercury 29.922 inches high and at a temperature of 32 degrees F., or a column of water 33.947 feet high at a temperature of 62 degrees F.

We are told that approximately the atmosphere decreases at the rate of about ½ lb. per sq. in. for every 1,000 feet of ascent and will increase in pressure by sinking a shaft below the sea level at the rate of about 1 inch rise in the barometer which is equal to .4908 lbs. per sq. in. for each 900 feet increase in depth.

It is quite evident then that the density and hence the pressure, is affected by the different elevations and temperatures of the air. For instance at a temperature of 62 degrees F., the density of one cubic foot of air=.076097 lb. when the atmospheric pressure=14.7 lbs. per sq. in.

While at a temperature of 212 degrees F., the density of one cubic foot of air=.059135 lb. when the atmospheric pressure would be equal to 18.92 lbs. per sq. in. The volume is increased from 13.141 cubic feet per lb. to 16.910 cubic feet per lb. respectively or $\frac{16.910}{13.141}=1.287$.

This volume and pressure will of course increase as the temperature increases as in the case of passing the air through a furnace, because we admit the air through the grate bars at a high density and by heating it we reduce its volume. If the increased volume meets with no resistance the pressure will remain normal, but if confined and not allowed to expand the pressure will increase.

Here we see why the air will rush into the ash-pit and through the fire, and the less resistance that is offered to the expanding air by coming in contact with the walls of the chimney and the external atmosphere at the top of the chimney, which of course is governed by the height of the chimney, the greater will be the flow of air, as before stated the higher the elevation the lighter becomes the atmosphere, here we see why the draft changes.

Differences in Draft.

It is a common thing to hear a fireman complain about his draft one day more than another, this might be explained in the following way. We find that air at a low temperature has a greater density and it takes less volume to weigh 1 lb., while the pressure of the atmosphere is less than with higher temperatures and greater volume, so that on a hot day a greater volume of air must be passed through the grate bars to furnish the required amount of oxygen to cause proper combustion than when the air is dry and cool.

While we noticed the change in volume and density between 32 degrees F. and 212 degrees F., we must not lose sight of the fact that with the great increase in temperature of the fire that the volume and density will also be greatly increased.

If we assume a temperature of the furnace fire to be say 2,500 degrees F., we have according to D. E. Clark.

$$W=\frac{1.3253\times28.75}{459.2+2500}=.01288 \text{ lb. per cubic foot.}$$

1=1 lb. weight

and $\frac{1}{.01288}=77.64$ cubic feet vol.

Where W=Weight in lbs. per cubic foot.

Where 1.3253=A constant used at 0 degrees F.

Where 28.75=Height of barometer in inches, which in this case is taken at 14.11 lbs. per sq. in. atmospheric pressure.

Where 459.2=Absolute zero, thus we find we have a density of the furnace gases of only .01288 lb. per cubic foot representing a volume 77.64 while the change in density would equal about 6.16 relatively

$$=\frac{.079439}{.01288}$$

were .079439=about the density of the air at 14.11 lbs. per sq. in.

The above demonstrates clearly the necessity of having plenty of space above the fire, and all along underneath the boiler to take care of this great volume of air due to expansion due to being heated up to this high temperature.

We must remember that this fire temperature depends upon the rate of combustion, that is the amount of coal burnt per sq. foot of grate surface.

This 2,500 degrees F. would represent a good hot fire burning about 24 lbs. per sq. foot G.S. per hour.

We noticed that the change in volume of air at 2,500 degrees F. equaled about 6 to 1, which goes to show the necessity of having a large space commonly known as a combustion chamber, which allows the different gases to become properly united, which is necessary for perfect combustion.

A very good conception of the necessity for plenty of space for combustion may be had when we consider that for every pound of hydro-carbon that is set free from the fuel, it requires 2 2-3 lbs. of oxygen, and one pound of air only contains by weight .236 parts oxygen, or $\frac{2.666}{.236}=11.3$ lbs. of air, and this does take into account the extra oxygen required to take care of hydrogen gas, etc., which will run the amount of air required up practically to 18 or 24 lbs. air per lb. of coal.

Measurements as before stated can be made by use of a U-tube connected up in the manner explained, that is the water in the leg which is connected in the space containing the heated gases will rise indicating that there is a difference of pressure between the inside and the outside of the furnace.

Every boiler should be provided with one of these simple gauges by which if a fireman will interest himself enough to watch, he will be able to tell to a very great extent the proper amount of draft to admit into his furnace in order to obtain the best results from the fuel he is burning. With an instrument of this kind a man has a very good knowledge of the atmospheric conditions and its effect upon his draft, because once he knows the amount of air to admit into his furnace to cause proper combustion and maintain a constant steam pressure, he can regulate his draft at all times providing he has plenty of it, either natural or mechanical draft.

Explanation.

The following will give a fair knowledge of what the change in level of the water in the draft gauge represents.

The difference in height of the water in the V-tube, that is, the distance from the top of the water in one leg to the top of the water in the other leg, represents the height of a column of water that can be suspended or sustained by the excess of pressure which would be created between the top and bottom of the chimney, or by the use of forced draft.

Tables have been prepared to show the height of the column of water at a given temperature to equal different pressures and are usually expressed in ounces per square inch, and are based on the following:

Where 1,728 cubic inches equal one cubic foot.

Where 62.49 lbs, equals the weight of a cubic foot of fresh water at 50 deg. Fahr.,

Then

$\frac{1727}{62.49}=27.7$ inches height of a column of water to equal one pound.

And

$\frac{27.7}{16 \text{ oz.}}=1.73$ inch to equal one ounce per square inch.

Or

$\frac{16}{27.7}=.578$ of an ounce per sq. in. for a column of water one inch high.

We must always bear in mind the effect of temperature changes on all these results. The foregoing is an advancement toward the sister subject, combustion, also efficiency of fuel.

ENERGY OF NIAGARA FALLS.

In reply to a correspondent, the following table gives the horse power developed by each of the seven operating companies at Niagara Falls. The total development of each company it stated as follows :

	h.p.
International Railway Co. ...	1,200
Electrical Development Co.	35,000
Canadian Niagara Power Co..	
Niagara Falls Power Co. (2).	122,240
Ontario Power Co.	58,700
Niagara Falls Hydro-Electric Power & Mfg. Co.	59,000
	276,140

The total available is calculated at 5,000,000 h.p.

A Study of Engine Indicator Cards; the Planimeter *

Use of Indicator Card is Shown, Characteristic Diagrams are Given and Faulty ones are Explained—Planimeter Facilitates Measuring Cards.

Indicator Diagram of a Single-Cylinder Engine.

The atmospheric line AB, Fig. 1, is a line drawn by pencil of the indicator when the connections with the engine are closed and both sides of the piston are open to the atmosphere.

The vacuum line, OX, is a reference line drawn at a distance, by scale, below the atmosphere line corresponding to the barometer reading; usually about 14.7 lbs.

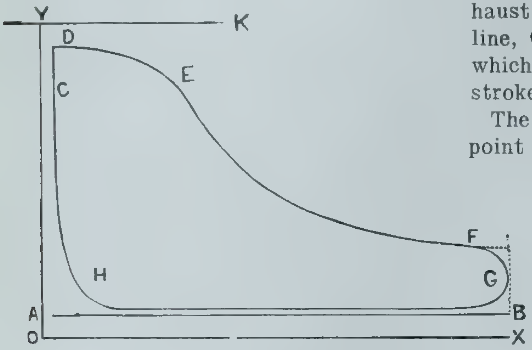

Fig. 1.—Card of Single Cylinder.

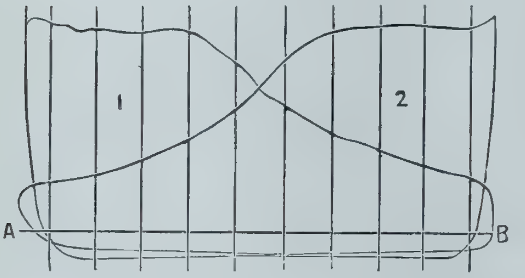

Fig. 2.—Finding Mean Effective Pressure.

The clearance line OY, is a reference line drawn at a distance from the end of the diagram equal to the same per cent. of its length as the clearance and waste room is of the piston-displacement.

The line of boiler pressure, YK, is drawn parallel to the atmospheric line, and at a distance from it, by scale, equal to the boiler-pressure shown by the gauge.

The admission line, CD, shows the rise of pressure due to the admission of steam to the cylinder by opening the steam-valve. The steam line, DE, is drawn when the steam-valve is open and steam is being admitted to the cylinder.

The point of cut-off, E, is the point where the admission of steam is stopped by the closing of the valve. It is often difficult to determine the exact point at which the cut off takes place. It is usually located where the outline of the diagram changes its curvature from convex to concave.

The expansion curve, EF, shows the fall in pressure as the steam in the cylinder expands doing work. The point of release, F, shows when the exhaust-valve opens. The exhaust line, FG, represents the change in pressure that takes place when the exhaust valve opens. The back-pressure line, GH, shows the pressure against which the piston acts during its return stroke.

The point of exhaust closure, H, is the point where the exhaust-valve closes. It cannot be located definitely, as the change in pressure is at first due to the gradual closing of the valve.

Compression curve HC, shows rise in pressure due to the compression of the steam remaining in the cylinder after the exhaust valve has closed. The mean height of the diagram equals its area divided by its length.

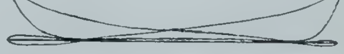

Fig. 4 —Light Load Single Valve Throttling Engine.

The mean effective pressure is the mean net pressure urging the piston forward—the mean height x the scale of the indicator spring.

To find the mean effective pressure from the diagram divide the length of the card as indicated by the length of the atmospheric line AB, Fig. 2, into a number, say 10, equal parts, setting off half a part at A, half a part at B, and nine other parts between; erect ordinates perpendicular to the atmospheric line at the points of division of AB, cutting the diagram; add together the length of these ordinates intercepted between the upper and lower lines of the diagram and divide by their number. This gives the mean height, which multiplied by the scale of the indicator spring gives the M.E.P. Or find the area by a planimeter or other means, and divide by the length AB to obtain the mean height.

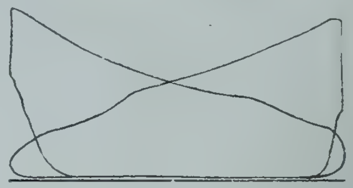

Fig. 5.—Heavy Load Single Valve Throttling Engine.

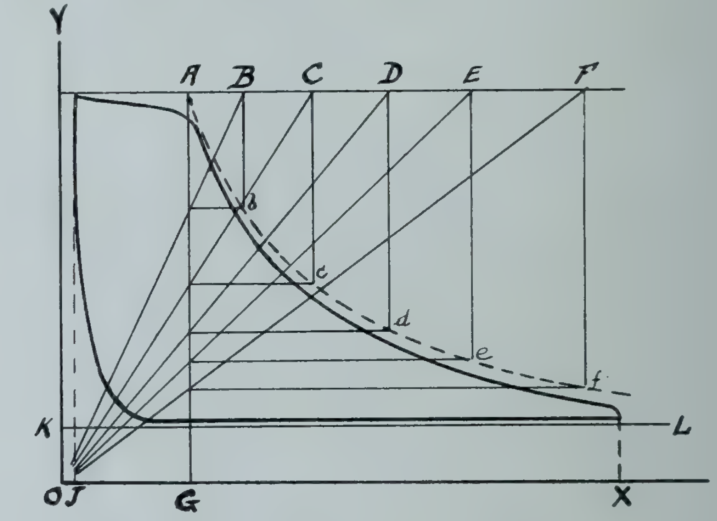

Fig. 3.—Drawing Adiobatic Curves.

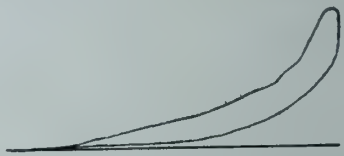

Fig. 6.—Light Load Single Valve Automatic Cut-off Engine.

The initial pressure is the pressure acting on the piston at the beginning of the stroke. The terminal pressure is the pressure above the line of perfect vacuum that would exist at the end of the stroke if the steam had not been released earlier. It is found by continuing

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* The illustrations used in this article were loaned by the Trill Indicator Co., Corry, Pa., manufacturers of Steam and Gas Engine Indicators, Planimeters, etc.

the expansion-curve to the end of the diagram.

Indicated horse-power of engines, single-cylinder, is found by the following formula :

$$\text{Indicated Horsepower (I.H.P.)}\ \frac{PLAN}{33{,}000}$$

In which P=mean effective pressure in lbs. per sq. in.; L=length of stroke in feet; A=area of piston in square inches. For accuracy, one-half of the sectional area of the piston-rod must be substrated from the area of the piston if the rod passes through one head, or the whole area of the rod if it passes through both heads; N=number of single strokes per min.; 2 x number of revolutions.

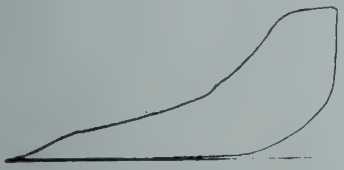

Fig. 7.—Heavy Load Single Valve Automatic Cut-off Engine.

Drawing Adiabatic Curves.

The expansion line on an indicator card from the point of cut off to the point of release should be an adiabatic curve, that is a curve which represents neither gain nor loss in heat. As the curves on actual cards never follow this line it is a good plan to draw an adiabatic curve on the indicator card for reference. To draw this curve absolutely accurately requires the use of a rather complicated formula, but as it very nearly corresponds to an hyperbola, it can be drawn by simple graphical means.

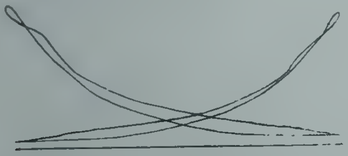

Fig. 8.—Friction Load Diagram of High Speed Single Valve Automatic Engine.

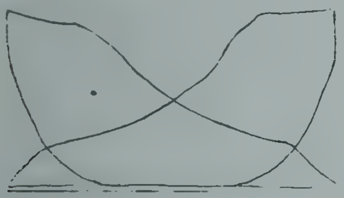

Fig. 9.—Heavy Load High Speed Single Valve Automatic Engine.

In the diagram shown in Fig. 3, the dotted line represents the curve so drawn. The vacuum line OX is drawn at a distance to scale, below the atmospheric line K-L, corresponding to barometer pressure, practically 14.7 lbs. 0-Y is the clearance line. Y-F is drawn parallel to O-X through the point of highest steam pressure shown on the card. Continue the expansion line up until it meets this line at A. Select any number of points B, C, D, E, F. Connect each of these points to O and draw the line A-G parallel to O-Y. From the point where the radial lines cross the line A-G, draw horizontal lines and from the points B, C, D, E, F drop vertical lines. Through the points where these two sets of lines meet draw the curve bcdef which is an exact hyperbola.

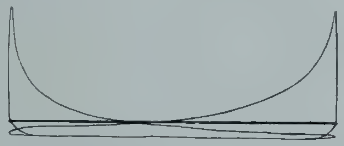

Fig. 10.—Ordinary Load Moderate Speed Corliss.

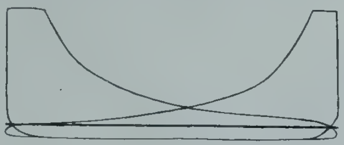

Fig. 11.—Light Load Moderate Speed Corliss.

As a matter of fact the true adiabatic curve is slightly below the curve as drawn above, but this curve is accurate enough for all practical purposes.

Characteristic Diagrams From Engines of Various Types.

Single Valve Throttling Engine.—Figs. 4 and 5 were taken with the same spring and illustrate very well the action of the governor. Fig. 4 shows a light load and Fig. 5 a heavy. The point of cut-off always remains at the same point, about three-quarters stroke, but as the load increases, more steam is admitted to the cylinder, and the initial pressure consequently rises.

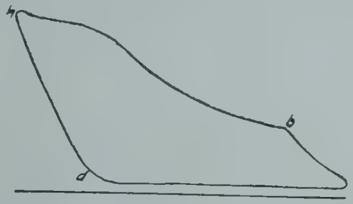

Fig. 12.—Admission Too Late.

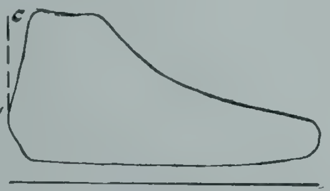

Fig. 13.—Admission Too Late.

Single Valve Automatic Cut-off Engine. —For light and heavy loads Figs. 6 and 7, the initial steam pressure is about the same, and as the load increases, the point of cut-off occurs later in the stroke. Compression becomes later as the cut-off increases. The points of admission and release change also, but not so noticeably as the cut-off and compression.

High-Speed (250-300 R.P.M.) Single Valve Automatic Engine.—Fig. 8 shows the "friction load" and indicates the work done in overcoming friction in the bearings of the engine. The diagrams for heavier loads, as Fig. 9, usually show large compression at these speeds, and the point of cut-off is seldom sharp.

Moderate Speed Corliss Engine.—Fig. 10 represents a load lighter than economical and Fig. 11 about ordinary load. When the valves are in good order there is always a characteristic sharp cut-off. Small compression is required because of slow speed and quick admission. The exhaust line being below the atmospheric indicates that the engine is running condensing. The amount of vacuum in pounds on the return stroke is the distance between the exhaust and atmospheric lines measured on a scale corresponding to the spring used.

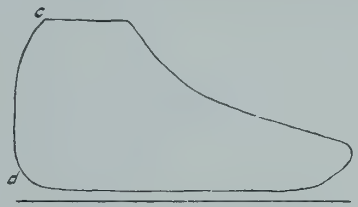

Fig. 14.—Admission Line Perpendicular.

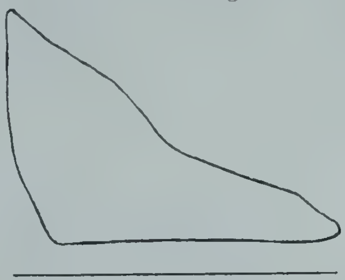

Fig. 15.—Steam Throttled During Admission.

Faulty Diagrams.

Admission Too Early.—The line (hd) Fig. 12 slants backward instead of being nearly perpendicular. In a single-valve engine, the cut-off, release and compression also will be too early as shown but in a Corliss these parts may not be affected. In the single-valve engine, the eccentric should be shifted on the shaft to decrease the angular advance. In the Corliss the lap of the admission valve should be increased. When release occurs too early as shown here (b) there is a

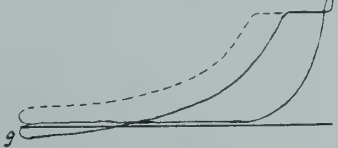

Fig. 16.—Cut-off Too Early.

loss of pressure due to the escape of steam. The valve should be set so that the drop from the expansion line to the back pressure line is as near as possible to the end of the stroke.

Admission Too Late.—The admission line (cd), Fig. 13, slants forward instead of being nearly perpendicular. With the Corliss or Releasing Gear it results from valves becoming misplaced or badly set. Admission may be made earlier by reducing the lap of admission valves. With single slide valve engines all other events are late also, as shown in the second diagram. The release occurs so late there is excessive back pressure at the beginning of the return stroke. The valve should be set so that the drop from expansion line back to pressure line is at the end of the stroke.

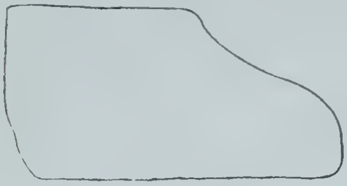

Fig. 17.—Cut-off Too Late.

Steam Throttled During Admission.—The steam line in Fig. 15, drops instead of being horizontal, indicating that the steam port is not open for a sufficient time.

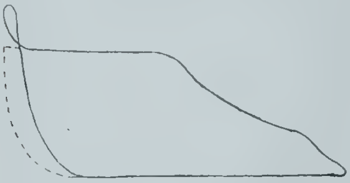

Fig. 18.—Compression Too Early.

Cut-Off Too Early.—Steam expands until its pressure is less than the back pressure, and the expansion line crosses the back pressure line to form the loop (g) in Fig. 16. This is frequently found on automatic cut-off engines working on light load. On such engines it is caused by too high steam pressure and wastes steam for the amount of work done, besides causing reversal of pressure and pounding. It cannot be remedied by resetting the valve. Steam must be throttled, the back pressure lowered by running condensing, or the engine run slower. The dotted line shows the result of slowing down the engine and cutting off later. Fig. 16 shows also the result of too early compression. The steam is compressed in the clearance space until the pressure rises above that in the steam chest.

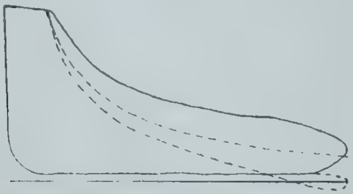

Fig. 19.—Leaks Indicated by Expansion Line.

Cut-Off Too Late.—This is characterized by a high pressure at release, Fig. 17, and means a big waste of steam due to its inability to do more work by expansion before the exhaust opens. The boiler pressure should be raised so that a diagram of equal area may be obtained with an earlier cut-off, or the revolutions of the engine increased, and the cut-off made earlier.

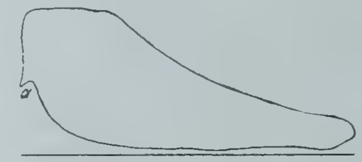

Fig. 20.—Leaks Indicated by Compression.

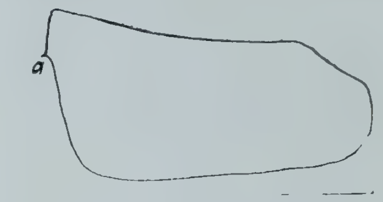

Fig. 21.—Leaks Indicated by Compression.

Compression Too Early.—The pressure in cylinder rises above that in the steam chest, and may cause chattering of the valve, pounding and heating, in addition to reducing the effective work of the steam. The dotted area plus the loop, Fig. 18, indicate the additional work obtained by setting the valves for proper compression. A similar loop may be caused by the absence of load on the steam valve, but when this fault occurs, the loop comes to a sharp point at the top.

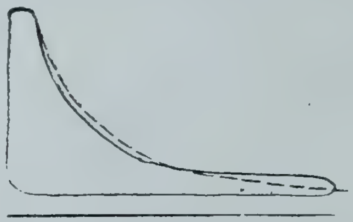

Fig. 22.—Condensation and Re-evaporation in Cylinder.

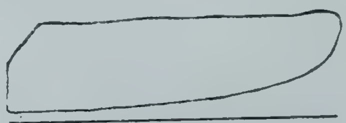

Fig. 23.—Diagram Showing Bad Distribution of Steam.

Leaks Indicated by the Expansion Line.—If the expansion line is noticeably above the theoretical adiabatic expansion line, Fig. 19, steam enters the cylinder through a leaky valve after cut-off. If the expansion line falls below the theoretical Fig. 20, steam leaks past the piston, or gets out through a leaky exhaust valve.

Leaks Indicated by Compression Line.—The curvature of the compression line changes as the piston nears the end of the stroke, sometimes even forming a hook, Fig. 21. This indicates the escape of steam from the compression space, either through the exhaust or past the piston.

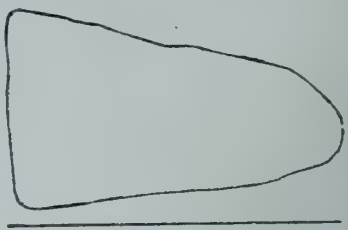

Fig. 24.—Diagram Showing Bad Distribution of Steam.

Condensation and Re-evaporation in Cylinder.—If the expansion curve falls below the theoretical adiabatic line at the beginning of the stroke, crosses and then goes above, Fig. 22, it is a fair sign that excessive condensation occurs at the beginning of the stroke, and re-evaporation during the latter part. Superheated steam will remedy such trouble, and restore the expansion line to the normal position.

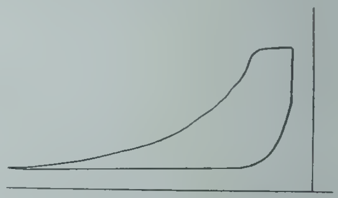

Fig. 25.—High Pressure Card, Compound Engine.

Two Very Bad Diagrams.—Fig. 23 shows the worst imaginable distribution and waste of steam. The adminission is late, there is almost no cut-off, and the steam port is opened so gradually that full steam pressure is not attained until the end of the stroke. The exhaust opens slowly and doesn't reach the proper point until two-thirds across the stroke.

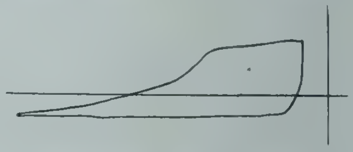

Fig. 26.—Intermediate Card, Compound Engine.

Fig. 24 shows a similar exhaust line, due in this particular case to excessive back pressure from the feed water heater.

Indicating Compound Engines.

Indicator diagrams of compound engines are taken in the same manner as on simple engines. The three cards Figs.

25, 26 and 27 taken from a triple expansion cross compound Corliss Engine. The cards for the different cylinders are taken with different scale springs in order that the areas of the cards might be large enough to show up well.

From these cards it is seen that the high pressure cylinder is working entirely above atmospheric pressure. In the intermediate cylinder the pressures run both above and below, while the low pressure cylinder works entirely below atmospheric pressure.

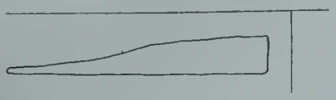

Fig. 27.—Low Pressure Card, Compound Engine.

In order that these cards may appear in a proper relation one to the other, they can be combined on one large diagram. To do this the pressures and volumes in the several cylinders have to be reduced to a common scale, and when so laid out the different cards fall in the position as shown. In the combined card, as shown, the total length of each card represents the volume of the corresponding cylinder in cubic feet.

The card shown in Fig. 28 for each cylinder represents the average for several cards for both sides of the piston. In laying out these cards the distance from the line of no volume represents the mean clearance volume for each side of the piston, for each cylinder.

In order to get some idea of the distribution of the steam in the various cylinders, it is generally customary to draw on the combined card saturation and adiabatic curves. One saturation curve cannot be drawn for three cylinders as the weight of the steam expanding in each is different, due to the different clearance volumes.

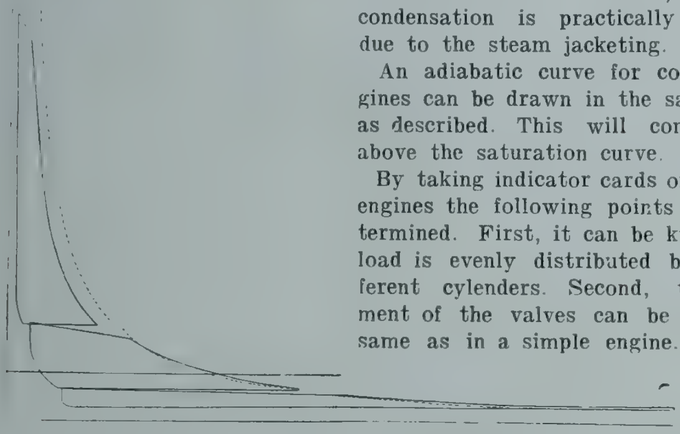

Fig. 28.—Combined Cards of Triple Expansion Engine.

The saturation curves are constructed by taking the values of the pressure and volume from steam tables, of the weight of steam expanding in each cylinder. The weight of the steam in each case being the steam used by the engine per stroke, plus the weight of the steam entrapped in the clearance space. The steam used per stroke can only be accurately determined by tests. The weight of steam in the clearance, is obtained by knowing the clearance volume in cubic feet, and the pressure at the end of compression taken from the indicator card, from which the weight can be obtained from steam table, by finding the weight of a cubic foot at the given pressure, from which the weight in the clearance volume is easily calculated. This should be done for each cylinder and saturation curves drawn as shown on the diagram.

In the engine from which these diagrams were taken, both the receivers and the cylinders were steam-jacketed, so that there is practically no drop in pressure between the different cylinders, and the expansion curves for the two lower cylinders correspond very nearly with the saturation curves, as cylinder condensation is practically eliminated, due to the steam jacketing.

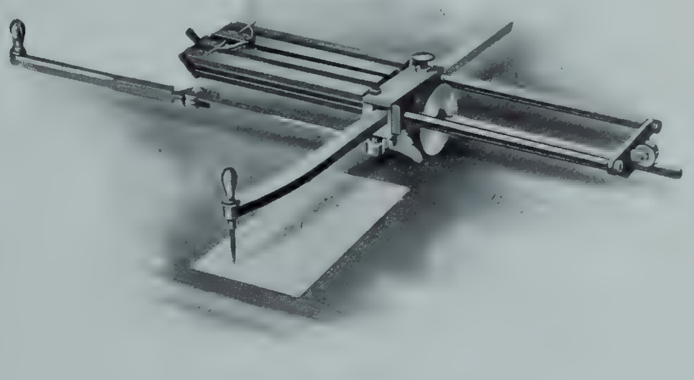

Fig. 29.—Trill Planimeter.

An adiabatic curve for compound engines can be drawn in the same manner as described. This will come slightly above the saturation curve.

By taking indicator cards on compound engines the following points can be determined. First, it can be known if the load is evenly distributed between different cylenders. Second, the adjustment of the valves can be known the same as in a simple engine. Third, by the difference in pressure between the exhaust of one cylinder and the admission of the next one, it can be known if the receivers and piping are of proper proportions. An excessive drop between cylinders may indicate excessive condensation or that the piping is too small.

The Planimeter.

The planimeter, Fig. 29, determines quickly and accurately the area of any regular or irregular figure. On indicator diagrams it not only gives the area, but may be set to give the mean effective pressure directly, no calculation being required. The wheel is mounted solidly on a long shaft, which in addition to its rotary movement slides on roller bearings in the direction of its axis. Area is indicated by the amount of this sliding motion as measured on a scale parallel to the axis The mean effective pressure is read direct by setting the adjustable tracing bar, which is at right angle to the shaft, so that the distance points are the length of the diagram apart.

WATER POWERS NEAR OTTAWA.

Fritz Cirkel, M.E., has been investigating the waterpowers and iron deposits in the Ottawa district. He estimates that power can be developed at Chats falls at $4.50 per h.p. year.

The horse power available along the Ottawa and Gatineau is as follows:

Ottawa river—L'Islet rapid on the Culbute channel, 2,000; Sable rapids, 3,800; Timber slide, 1,400; Garvin chute, 5,000; Crawford rapids, 7,000; Black rapids, 5,700; Muskrat rapid, 7,000; Rocher Fendu chute, 5,600; Grand Calumet falls, 25,000; Mountain rapid, 13,000; Dargis rapid, 4,500; Portage du Fort, 400; Chats falls, 50,000; Deschesnes rapids, near Ottawa, 35,000; Skeads mills, near Ottawa, 25,000; Chaudiere falls, Ottawa, 70,500; Black River falls, near Weston, 21,000; Coulonge River falls, near Fort Coulonge, 24,120; total, 306,020 horsepower.

Gatineau river—Six portages, below Maniwaki; Head of six portages, 2,820; The Corbeau, 5,520; The Boom, 4,960; Les Cedres, 3,220; La Passe, 350; Le Bonnet Rouge, 875; the Paugan falls, 73,500; The Cascades—First cascade, 1,300; Second cascade, 1,500; Third cascade, 1,000; Fourth cascade, 4,000; Fifth cascade, 2,200; Chelsea rapids; Eaton chute, 17,640; Shingle mill, 47,404; Chelsea falls, 50,400; total 216,325 horsepower.

The grand total of available horsepower is therefore 522,345

The Scientific Insulation of Brine and Ammonia Lines

Savings That may be Made by Insulation must be Considered if the Plant is to Give the Greatest Economy—Statement of Costs are here Given.

By C. R. LYLE *

No sane man would allow steam that ought to be turning machinery to escape from broken pipes. Nor is electric power permitted to go to waste by failure to insulate properly the supports on which the wires are carried. Yet many men of experience and intelligence refuse to recognize the fact that there is just as constant and serious loss involved in leaving brine and ammonia lines uncovered. True, this loss of energy cannot be seen as clearly as a jet of hissing steam nor is it as obvious in the effect it produces as a grounded electric current. At the same time the waste is going on steadily every minute that the plant is in operation.

It seems strange, in view of the attention that is now given, and justly, to the scientific insulation of cold storage rooms and buildings and freezing tanks, that the proper insulation of brine and ammonia lines should have received such scant consideration. Walls, floors and ceilings are covered with the most efficient types of insulation, carefully designed and installed; the importance of having the very best cold storage doors and windows is generally recognized. Yet little or no care is usually taken to protect the refrigerating medium from the heat while it is passing from the machine to the room or tanks where its energy should properly be spent.

The reason for this neglect may be that the loss is not actually seen or felt, but it is more probable that the underlying reason is that there is a general misconception of the amount of waste uninsulated brine and ammonia lines occasion. The average man would not think for a minute that two hundred feet of one and one-half inch brine pipe carrying brine at 15 degrees Fahrenheit with the air at 90 degrees Fahrenheit would entail a loss of $204.00 a year with refrigeration at fifty cents a ton. Yet this is a fact, as shown by the latest and most authentic data. And it should not be lost sight of either, that the actual loss is greater than this, since uncovered brine pipe deteriorates in service much more rapidly than a line that is insulated properly.

Efficiency.

The insulating efficiency of any pipe covering depends on the volume of dead air it contains. The service conditions, which brine and ammonia pipe covering has to meet, are far more severe than in the case of covering for hot pipes. With the latter the internal heat tends to keep the covering, whatever it may be, dry and efficient. With cold pipes, the conditions are exactly reversed. All physical laws may be said to be arrayed against the covering. The air in the air spaces in the covering close to the pipe is cooled down as soon as the refrigeration is turned on. As the air cools, it contracts. This produces a partial vacuum and at once the atmosphere presses in in its endeavor to restore equilibrium. If nature is successful, if outside air does force its way in, the ultimate fate of the covering is assured. For the warm outer air will carry in moisture in the form of vapor, which will condense as soon as it is cooled down and be deposited right in the heart of the covering. This process will go on every moment that the plant is operating. The air spaces in the covering will soon fill up with frost. As soon as the refrigeration is turned off, the frost melts and thoroughly saturates the covering, rendering it worthless from an insulating standpoint since water is an excellent conductor of heat. When the refrigeration is turned on again, the water freezes, disrupts the covering and ultimately causes its complete destruction, accompanied at times with offensive odors. It is obvious, therefore, that besides being an efficient non-conductor of heat, any material used for this purpose must be absolutely non-absorbent, not only that its efficiency may be lasting, but that the covering itself may be reasonably durable in service.

Expediency demands that whatever material is used should be easy to apply as this reduces the cost of installation. Furthermore, the covering should present a neat and finished appearance and not make the line bulging and unsightly. Last, but not least, cold pipe covering should be reasonable in cost, taking into consideration not merely the first cost, but the cost in the long run.

Different Types.

A number of different types of covering have been devised for this service, but practically all of them will be found wanting in respect to at least one, if not more, of the requirements just mentioned. Felt coverings, for instance, are of fibrous character and hence possess capillary attraction—a tendency to suck in moisture from the outer air. Furthermore, the air spaces in coverings of this character are not absolutely independent of each other but are merely interstices between the closely matted fibres. One can readily appreciate, therefore, that with any covering of this description, it is merely a matter of time until moisture penetrates its structure rendering it worthless, and causing rapid deterioration. Coverings, in which paper and rope figure, are subject to the same objection.

Summing the matter up in a word, coverings of this character may be efficient when they are dry, but it is impossible to keep them in that condition. No matter how carefully the attempt is made to waterproof them, sooner or later the moisture will effect an entrance somewhere. Then, like a malignant disease, the trouble will spread and in a comparatively short time the covering will have to be torn off and replaced. Furthermore, the majority of these materials are difficult of application. Most of them are exceedingly cumbersome, consisting of many wrappings and layers. This, naturally, materially increases the cost of application and the expense of the repairs which will certainly be necessary in a short time.

Cork Insulation.

In cork, however, nature has supplied a material peculiarly well suited for this particular service. This strange substance, which is put to so many and widely diverse uses, is the outer bark of the cork oak, a tree that flourishes in the Spanish Peninsula and Northern Africa. The climate of these regions is hot and semi-arid. But the heavy outer bark of the cork tree, sheathing its trunk and branches, prevents the sun's rays and the parching winds from heating and drying up the cool, life-giving sap. After passing through varied manufacturing processes, cork bark reappers in the form of cork pipe covering to render similar service in protecting cold pipe lines from the heat.

For the reason why cork should be so well suited for this purpose, one need not seek far. Put a piece of the material under a microscope, magnify it one or two hundred times and its peculiar structure may then be clearly seen—myriads of minute sealed air cells impervious, both to air and moisture. In short, cork furnishes "dead air in its deadest form." The air that it contains is so effectually bottled up in microsco-

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* Of the Armstrong Cork Co., Pittsburg, Pa., represented in Canada by the Philip Carey Co., Toronto.

pic particles that circulation is impossible. This not only accounts for its low heat conductivity but also for its great durability as an insulation for any cold surface. The moisture cannot penetrate its sealed air cells, there is no capillary attraction, therefore the material keeps dry and retains its original efficiency indefinitely.

By the processes through which the material passes in the course of manufacture, these natural and inherent insulating qualities are appreciably increased. Cork pipe covering is manufactured by slightly compressing pure granulated cork in molds of proper shape and size, which are in turn passed through a baking process which brings out the natural gum of the cork itself, binding the whole mass together firmly. No artificial binder is used for the simple reason that none is necessary. The natural gum is not only water-proof but proof also against acids and alkalis. This baking process increases the efficiency of the raw material, first by driving off all moisture and part of the volatile matter and, second, by coating the surface of each separate granule with a thin film of the natural waterproof gum which effectually prevents the re-entrance of moisture.

As the covering comes from the molds, it is coated inside and out with a mineral rubber finish which serves as an additional protection against the moisture of condensation. Its sectional form renders its application easy and rapid. In putting it on, the joints are sealed with waterproof cement making the covering to all intents and purposes a homogeneous mass. Its appearance is neat and symmetrical.

Cost.

The one point that still remains to be considered is cost. Undoubtedly cork covering does involve, at the outset, a somewhat greater outlay than certain of the other kinds of brine and ammonia covering, but when the saving that it effects in preventing loss of refrigeration and its long life in service are taken into consideration, comparison is out of the question. The results of a recent series of tests prove, conclusively, that cork pipe covering applied to brine and ammonia lines here in Canada will pay for itself in a little more than a year. A concrete illustration will make this point clear.

Let us assume that we have 200 feet of 1½'' pipe carrying brine at 15 deg. F. with the average temperature of the air outside 90 deg. F. The loss through this 200 feet of 1½'' pipe, bare, is 322.027 heat units every twenty-four hours. The loss through the same pipe covered with cork covering, 2½'' thick, is only 59,443 heat units. Hence the saving is 262,584 heat units—equivalent to 91.100 of a ton of refrigeration—every twenty-four hours. It costs approximately 50 cents to produce a tone of refrigeration. Therefore, the covering would save 45½ cents every day, or $166.08 a year.

Since this 200 feet of 1½'' cork covering, applied in Canada, would cost only about $190.00, it would actually pay for itself in fourteen months, or in other words, it would yield 87 p.c. on the investment.

ICE-MAKING AND REFRIGERATING MACHINERY.

This is the title of a series of bulletins made up in book form by the Kent Co., Ltd., Refrigerating Engineers, Montreal, and shows the various types of ice making and refrigerating machines manufactured by the York Mfg. Co., York, Pennsylvania. This collection of bulletins is very complete and gives the main dimensions of all the different sizes of machines. Besides this these bulletins are very complete and give the main dimensions of all the different sizes of machines. Besides this these bulletins include some very interesting and authoritative papers by different refrigerating experts and useful tables regarding refrigeration. Any engineers interested in refrigeration will find these bulletins exceedingly useful and instructive and the collection will be sent free to anyone requesting the same and mentioning this paper.

Ammonia Fittings and Supplies—Is the title of another catalogue we have received from the Kent Co. It is very handsomely gotten up and gives the sizes and dimensions of the various ammonia fittings manufactured by the York Mfg. Co. Included in this catalogue are several tables relating to ammonia and refrigeration, such as "Properties of Saturated Ammonia Gas," "Table giving number of cubic feet of gas that must be pumped per minute at different condenser and suction pressures to produce one ton of refrigeration in 24 hours." This book will be sent upon request to those interested.

Nonpareil Corkboard Insulation—Is the title of a handsomely gotten up book on insulation, referring particularly to the Nonpareil Corkboard Insulation manufactured by the Armstrong Cork Co., Pittsburg, and distributed in Canada by the Kent Co., Ltd., Montreal. It gives as an introduction some good matter on insulating properties of various materials and their uses and also shows the way in which the Armstrong Co. have thoroughly tested the Corkboard Insulation. The cuts are very appropriate and are well shown. This book should prove of great interest to anyone interested in insulating cold storage plants and the like.

REFRIGERATION ARTICLES.

Chatham, Ont.,
March 9, 1910.

G. C. Keith,
Editor The Power House.

Dear Sir.—I wish to commend you for the articles on refrigerating and ice-making machinery appearing in The Power House. I would like to see you take up the question, dealing with it from the first principles, giving full descriptions of refrigerating and ice-making machinery.

The ordinary engineer knows nothing of the subject and it should be dealt with from the rudiments of subject, taking up the care and management of refrigerating and ice-making machinery.

Trusting this suggestion meets with your approval, I am,

Yours faithfully,
CHAS KELLY, Executive,
Pres. C.A.S.E.

REFRIGERATION SYSTEM.

In the February issue of The Power House, reference was made to the Gravity Brine System. This system is patented in Canada and United States, by the Madison Cooper Co., refrigeration engineers, Watertown, N.Y.

CAPACITY OF AMMONIA COMPRESSOR.

How do you determine the refrigerating capacity of an ammonia compressor, 10x16-inch, running at 75 revolutions per minute? How many feet of 2-inch pipe can one allow for refrigeration and how many feet of 2-inch pipe for ice making? A. R. M.

A double-acting compressor having a stroke of 16 inches and running 75 revolutions per minute has a piston speed of

$$\frac{2 \times 16 \times 75}{12} = 200$$

feet per minute.

The area of a 10-inch piston is 78.540 square inches equals 0.5454 square foot. The volume swept through by the piston under the above conditions is the same as though it traveled in one direction and would be

$$0.5454 \times 200 = 109.08$$

cubic feet per minute.

There is no generally adopted standard among builders of refrigerating machines for fixing the rating of compressors. The number of cubic feet of piston displacement per minute to produce a cooling effect equal to the melting of a ton of ice varies widely with the condition of liquid temperature at the expansion valve and vapor pressure within the expansion coils, and, of course, varies with the efficiency of the compressor or the ratio of the actual to apparent displacement.

Assuming the compressor has 100 per cent. efficiency, 8 cubic feet would be required under the conditions of 200 pounds head pressure and 0 pound back pressure; while at 100 head pressure and 40 pounds back pressure only 2.05 cubic feet would be required per minute per ton of cooling effect per twenty-four hours.

In a paper read before the American Society of Mechanical Engineers, June, 1905, on the subject of Standard Unit of Refrigeration, it was determined that the average practice of large builders corresponds very closely to 4.4 cubic feet per minute from liquid at 90 defrees Fahrenheit and evaporating at 0 degree Fahrenheit or 15.67 pounds back pressure, assuming a compressor efficiency of 90 per cent. There use of the factor of 4.4 would give

$$\frac{109.8}{4.4}=24.7 \text{ tons.}$$

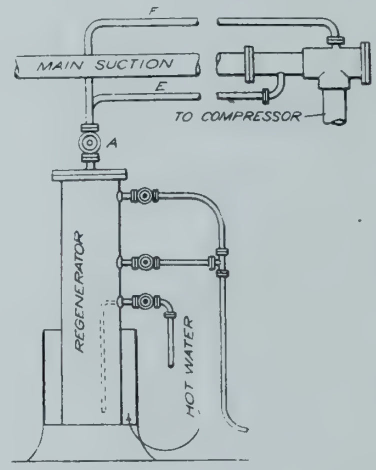
For direct-expansion ammonia piping in rooms of ordinary temperature (36 degrees) 350 feet of 2-inch pipe should be installed per ton. This corresponds to a difference of temperature of 22 degrees Fahrenheit between the ammonia on the inside and the air on the outside of the pipe. Where a greater difference exists a smaller amount of pipe surface can be used and when the difference is smaller more surface is required. In ice making by the can system 90 to 100 square feet of pipe surface is used.—Power.

INSULATING CONCRETE BUILDINGS WITH CORK.

A few years ago had one been told that he could take four inches of an up-to-date insulating material and secure equal or better results than could be obtained by the use of twelve or fourteen inches of wood and air space in cold storage construction, he would have become suspicious and thought of "gold bricks" especially if it were added that this insulating material could be put up in Portland cement and finished with the same material, thus practically cutting out all wood work. Nevertheless, such is an established fact, and by this method the cost of insurance can be vastly decreased and the building for cold storage made as nearly fireproof as is possible. Such a material can be applied directly to concrete walls in buildings for general use, and for ceilings can be put in the concrete forms and the concrete poured directly on it. In this country, while such materials have been used in cold storage work with great success, little or no effort has been made to adopt them for use in general building, as has been done in Europe, where great strides have been made in adopting it for insulating and isolating purposes. In all classes of buildings, such as halls, lecture rooms, gymnasiums, spinning and weaving mills and paper mills, it is being used in various ways to reduce heat loss, to prevent condensation of moisture on the walls in cold weather and prevent transmission of sound, etc. The material used in Europe is usually termed corkstone and is made of granulated cork. In this country pure granulated cork, formed into sheets, is used, as well as the German impregnated cardboard. These sheets are usually made in sheets or boards, 12 to 36 inches, from 1 to 3 inches thick. They can be worked in many ways and used in many industries. They can be cut, sawed, planed, nailed to beams and built up with plaster, lime, or cement mortar.—Cement World.

REGENERATOR CONNECTION.

Don't you think the proper way would be to have the regenerator connected as at E on sketch, so the dead liquid could drop in before it reached the compressor? The regenerator was connected as shown by the pipe F when I took charge of the plant.—E. W.



Regenerator Connections.

A.—The connection of the regenerator would better be left as at F. The obpect of the regenerator is to remove from the ammonia all impurities. If the connection is changed, as at E, there will be some liquid flowing from the main suction pipe down into the regenerator against the current of ammonia gas going from the regenerator towards the compressor. This would be likely to result in the gas picking up some oil and impurities from the drip. If there is much bother with liquid shooting into the compressor, put in a separator in the main suction line and take the liquid from this to a receiving tank, from which it can be pumped back into the expansion system under pressure.—Practical Engineer.

REFRIGERATION MACHINERY.

A neat catalogue descriptive of refrigeration and ice-making machinery has recently been issued by the Vilter Mfg. Co., Milwaukee, Wis. The whole system of refrigeration, etc., is dealt with, tables, drawings and numerous illustrations being made use of to make the whole subject clear to the reader. A card will bring the catalogue if you mention The Power House.

ENGINEERING CONUNDRUMS.

The following are a few engineering conundrums from the "Question Box" of the National Electric Light Association. Answers from any of our readers would be welcome.

1. Is it good practice to operate condenser auxiliaries at a maximum and uniform rate of speed regardless of atmospheric and load conditions? Wil, the saving effected in power and heat in the hot well of surface condensers compensate for the cost of additional attention? If so, what calculations or operating conditions are available to show this?
2. In a central station containing several different sized units, how far should the practice of providing individual auxiliaries, such as circulating pumps, air pumps, boiler and feed pumps, heaters, etc., be carried and what are the reasons therefor?
3. In well-covered steam pipes carrying superheated steam, does the friction on the sides of the pipes further superheat the steam?
4. How is it possible for water to collect in pipes carrying superheated steam?
5. What has been the experience of companies using Curtis turbines, as to the relative value of oil and water for use under the step?
6. In large turbo-generators, 300 to 14,000-kw. capacity, with speeds of 1,500 to 500 r.p.m., how much energy is lost in windage and friction?
7. Are steam turbines up to 1,500-kw. capacity proving more efficient in actual practice than Corliss engines of the same size?

J. Darlington Whitmore, A.M. Can. Soc. C.E., recently resigned his position as city engineer of Moose Jaw, Sask., to take up private work. He will open an office in Regina, Sask., at the corner of Scarth and Railway Sts., as a consulting, sanitary and municipal engineer, specializing in sewerage, sewage disposal and pure water supply questions.

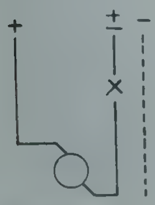
PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

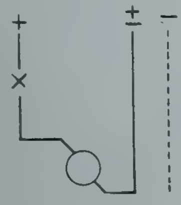
TROUBLES WITH ELECTRIC MOTORS.

By J. A. S. Newcastle.

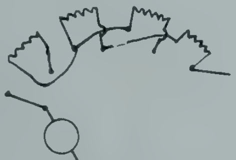
The electric motor while being a good and faithful servant is nevertheless subject at times to serious derangement which may be due either to internal weakness or bad treatment. The very fact that a motor usually runs with such minimum of attention is in itself likely to produce the danger that it is not sufficiently looked after, and moreover, when trouble does actually occur it is emphasised by the preceding smooth running. In many works sufficient precaution is not taken to secure adequate spares, either in the way of complete motors or of interchangeable renewable parts and in this way the serious nature of a motor breakdown is much aggravated. It may therefore be of interest to relate one or two instances in connection with break downs of small motor installations and the way they were overcome, in order to illustrate good methods of overcoming difficulties of this nature.



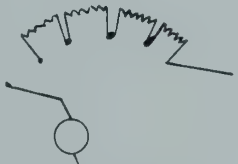
Wrong Connection.



Correct Connection.



Obviously Incorrect Arrangement.



Correct Arrangement.

In one instance an electric motor was employed to give the necessary power to a combined shear and punch in a shipbuilding yard, and attached to the gearing connecting the motor to the machine was a heavy flywheel placed there in order to minimise the fluctuations of load or shock on the motor itself during the operation of the punch. The attendant, however, forgot that such a motor should have been started up gradually in order to allow the effect of each resistance stop to be felt. Owing, to the internal friction of the machine the motor did not start up until about the fourth stop of resistance, and then the starter was operated too quickly on the remaining stops, resulting in the over load coil and the starter being burnt out and then going to earth. This resulted in the operation of the automatic circuit breakers at the power house which cut out the circuit. A new over load coil was obtained and fitted and normal conditions then applied. Later however, a starter of larger capacity was used and special care was employed in starting up. In the case of motors driving pumps or machines with heavy flywheels great care should be taken in starting up and in seeing that everything is free. If the motor does not start up on the usual stop there is some abnormal condition which must be examined into before further risks are taken.

An interesting accident which occurred in connection with a small motor installation was due to the fact that the single pole main switch by means of which the motor circuit was controlled was placed on the dead side of the circuit. The motor being a small one was connected across the outer and middle conductors of a three-wire system, a spanner was accidentally dropped on to the brushes of the motor while it was shut down and as pressure was on the commutator an earth was set up which damaged the commutator and blew the fuses. In order to get over this until a double pole switch could be secured the connections were changed over on the main switch so as to put it on the live side; this is shown in the figure attached. It should be remembered that a motor circuit should preferably be controlled by a double pole switch fixed so as to command both the live and the dead side, but where single pole switches are used they should never on any account be inserted on the middle wire of a 3-wire system.

Another small accident which is instructive in connection with small motor work was the shifting of the brush rocker of a motor. This rocker was held in place by the grip of a split collar upon a support made to receive it. The motor had been running for some time and continuous vibration gradually caused the rocker to work loose, and gradually the rocker dropped back, owing to the friction of the commutator. This shifting of the commutator caused the motor to flash over and the fuses were blown. The nuts holding the split collar were tightened up and the rocker reset. After cleaning the commutator and putting in new brushes the motor was quite sufficiently good to run again; but in order to bar against further trouble a hole was drilled in the collar and a screw fixed to bite the end carrying the collar.

One other accident which occurred in connection with a small motor installation, may be quoted to show the diversity of trouble which may be found in such work. The cause of this breakdown was due to the wrong connecting up of the resistance controlling one of the motors on a walking crane in an engineering shop. The trouble first of all originated in the fact that a considerable amount of dampness was found on the motor and controlling gear, and in order to avoid a breakdown the gear was disconnected and dried out. When the time came to replace the parts, however, the resistance leads and terminals of the controller were accidently interconnected; this resulted in the very erratic behaviour of the motor when an attempt was made to run it. As the handle was moved from stop to stop the motor first ran up over speed and alternately slowed down violently and finally the resistance burnt out. This involved the fixing of new resistance coils, and when these were being connected up all connections were gone over and tested and each lead and its proper terminal were verified by testing them further with an ohmmeter. The wiring diagram was by this means corrected from the obviously wrong arrangement to the second system of connecting shown in the figure. In order to prevent a recurrence of this trouble at any future time, strict orders were given to the wireman in the engineering establishment mentioned to label the terminals and leads carefully and it is most important when disconnecting machines or other apparatus, to avoid the possibility of any doubt in connecting up again by labelling or in some way marking the different leads and terminals

Although the above examples are only two or three picked here and there from a large series of breakdowns such as must occur within the experience of any practical electrician entrusted with the management of a power installation, they may be useful as indicating the various causes of trouble which may be expected in small electric motive power installations.

PUTTING ENGINE ON CENTRE.

By S. A. Ameson.

I send this to The Power House, it may do some beginner some good.

Place the engine in a position where the piston will have very nearly completed its outward stroke, and opposite some point on the cross-head (as a corner), make a mark upon the guide. Put up a pointer that will point to the rim of the fly-wheel and make a mark at the point of the pointer on the wheel. Now turn the engine back until the cross-head comes to the mark on guide and then make another mark directly in front of the pointer on the fly-wheel. Next divide the space between the two marks on the fly-wheel, and turn the engine until the pointer is at centre mark. Now the engine is on perfect centre.

To place the eccentric at right-angles to the crank when the piston is at either end of the stroke:

1. Fasten a planed board at the eccentric side of the engine in such a position that it will come under the eccentric rod.
2. Put on the straps and rod loosely.
3. Hold or fasten a pencil to the rod, and have an assistant turn the eccentric once around, holding the pencil so that it will mark the exact travel of the rod on the board.
4. To get eccentric at right-angles, find the centre of this line with a pair of dividers or a rule.
5. Turn the eccentric up until the pencil comes to the centre of line.
6. Fasten the eccentric so that it won't slip. It is now at right-angles to the crank.

OIL FILTER.

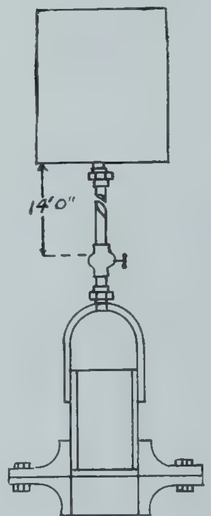
By John Richardson.

A short time ago I had charge of the Fog Alarm station at Pachena Point, Lighthouse, West Coast of Vancouver Island. There were three Fairbanks-Morse vertical internal combustion engines of twelve h.p. each, running on kerosene. Each engine consumed nearly 12 pints per hour. Though the combustion of the oil appeared to be perfect as the exhaust was practically invisible yet after a run of six hours some two or three pints of kerosene would accumulate in the base of the engine which must have been forced down past the piston rings from the combustion chamber above. This oil was inky black with fine particles of carbon.

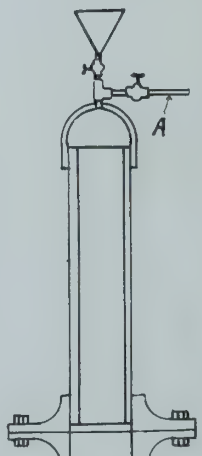
At first I threw this dirty oil away as useless until I hit upon a plan for filtering it. Having a good supply of spare pipe fittings I took two 6 inch pipe flanges and bolted them together tight with three thicknesses of fine flour sacking between them. Into one flange was screwed a short piece of six-in. pipe, closed with a pipe cap, into which I fitted a quarter inch pipe 14 feet long, which went up through the ceiling into the loft. To the upper end I connected an empty kerosene can into which the dirty oil could be emptied as it was drained from the engine bases. The fourteen foot head gave enough pressure to force the kerosene through the filtering cloths which took practically all the carbon out of the oil. I then put the filtered oil back into the engine tanks where it seemed to work satisfactorily, with quite a saving in the fuel bill.

The filter cloths needed cleaning after filtering a couple of gallons. To do this all that was necessary was to shut off the oil from the supply can upstairs by a valve above the filter, then unbolt the flanges and change the filtering cloths.

I also made a similar filter to purify the waste lubricating oil that collected in the drip tins under the bearings. Taking a piece of four inch pipe about 3 feet long, with a pipe flange coupling screwed on one end, I bolted another flange to it with filter cloths between them as before. In addition I put in a good plug of cotton waste. The upper end I capped and fitted with a half inch T, one branch of which connected with a compressed air tank at 30 lbs. pressure and the other with a funnel for filling the filter, there being a valve in each connection. When filled through the funnel I closed that valve and opened the one in the air connection which then forced the oil through the filter cloths making it fit for further use.



Gravity Kerosene Filter.



Pressure Oil Filter.

ELEVATOR TROUBLES.

By J. H. Shales.

As a rule troubles arise from lack of attention to the machines, by those in charge. As long as a machine will respond to power, it is let run regardless of its physical conditions. It may have been badly worn cables, or rust eaten piston rods, or burnt out contacts, no oil in warm gear, worn out bearings, safety out of order and a host of other infirmities. But as long as it will go up and down, people will use it, jeopardizing their lives and limbs, month in and month out. I have been called in to examine elevators in this city that had been in use for months without having a drop of oil put on the running parts or overhead sheaves. I have seen overhead sheaves bearing cut down through the babbitt and ½-inch into the metal and the shaft scored so that we had to put in new ones. This happens in scores of buildings.

I have one in mind that came under my notice two years ago in a leading hotel within a block of where we are assembled. The manager and engineer's attention had been called to the worn out condition of the machinery, but they thought it could run a little while longer, and so it went on until the armature gave out through over work, and they had to shut down for four days and make repairs, costing them four times the amount that it would have done if they had given it proper care. It is surprising how careless the owners of buildings are about their elevators. And when their attention is called to the need of repair, they will say it should run without looking after, forgetting that iron and steel want looking after as well as the human body.

This brings to mind a case I had some years ago of an electric elevator I had installed in one of our large hospitals. It had been in some months and was giving trouble occasionally through not having a steady operator. On this occasion, as I was leaving the building, I was met by the medical superintendent and was asked if the machine was all right now. I said: "Yes." "Well, how long will it stay that way?" My reply was the Irishman's answer, by asking him: "Doctor are you well now?" Of course he said "Yes." "Well how long will you remain that way?" Needless to say, I was not asked that question again, although I have done the repair on that machine for seventeen years. This is but one of hundreds of thoughtless questions we have to answer in our business.

Fifteen years ago we had great trouble in getting architects to give us room to put in elevators. They thought any old place was good enough for the elevator, forgetting that those machines would need repairs. And through this short-sighted policy it has cost owners hundreds of dollars for repairs which would have been saved if the machine had been placed where they could have been looked after.

In one of our large office buildings we were installing a first class hydraulic plant, and when we came to set up our valves and control machinery, we could not get them in place on account of having a small lavatory in the way. This room is 5x6 on the ground floor with a large lavatory within 20 feet on the same floor. After a great deal of coaxing, the architect gave orders to move the terra cotta wall 18 inches. This just gave us room to get our machines in position. But for the last 18 years, every time there are repairs made the architect is cursed for his folly, as the small room is not used and is of no value to the building for revenue. I have met with instances like this in my 25 years' experience in elevator work.

My advice to all persons in charge of elevators, is to give them the same attention you would give a steam engine, as they are only hydraulic electric engines in the true sense and produce power to operate the cages.

If your plant is an electric one, be sure that all contacts are clean and have good faces. Also that all connections are firm and tight. Those parts should be gone over and tested every day. Also keep an eye on all ropes, overhead sheaves and bearings. Also keep your girder well oiled and car properly adjusted as well as cables tuned up. When this is done on either electric or hydraulic machines, you will be all right.

COMMERCIAL COAL.

By Karl M. Way.

The rapidly growing interest that is being manifested by consumers of coal in its fuel value and its adaptability for use under different types of steam boilers will, it is hoped, in a very short time demand more stringent and uniform methods on the part of the coal operators in the different coal fields in the preparation of their fuel for the market. There is no doubt that in the very near future all large contracts for coal, as well as the majority of smaller ones, will be made on the British thermal unit basis. The United States Government under the pressure of a fuel bill approximating seven million dollars a year recognizes the advantages of this system, and almost all the departments of the government service are now purchasing coal on the heating value basis. It is a recognized fact that the new system of purchasing coal is meeting with approval not only with the consumers, but with the coal operators as well, and especially those operators who by virtue of the efficient system of preparing their coal at the mine can deliver to their sales agents a product that will meet the requirements laid down in the specifications.

Articles that are appearing from time to time in the different periodicals through the passes of the boiler instead of sampling coal and point out that it is by no means an easy task to secure a representative sample of a consignment of coal. In view of this fact it would seem expedient on the part of those coal operators who have not already done so, to establish at their mines and put into effective operation a system regulating the cleaning and preparation of their coal that would not be made secondary to any other department necessary to successfully carry on mining operations. The advantages of such a system can be very readily seen. The output of the mine would become more uniform in quality, making it less difficult to procure a representative sample, and at the same time diminishing the uncertainty existing in power plant control when operating under varying fuel. In this paper it is not the purpose of the writer to enter into a lengthy discussion of the various types of coal washers that are in use in the different coal fields, but to take into consideration those mines where the coal is cleaned on picking tables or in railroad cars. It would be quite impossible to formulate a system of inspection, other than in a general way, that would meet the conditions existing throughout the country.

In the Rocky Mountain province an entirely different proposition from that existing in the interior and eastern provinces will be found to exist. In the former case the impurities in the bed of coal are quite liable to be disseminated promiscuously through the coal bed, whereas in the eastern field a more consistent relative position is assumed. Compare a western coal, which the writer recalls ran 8 per cent. sulphur, the sulphur being of the very thin, flaky variety, with an Illinois coal where if a room on one side of the mine contains a 1½ inch sulphur band 8 inches from the floor it is almost certain to be found on the opposite of the mine occupying practically the same stratigraphical position with reference to the coal bed.

The roof and floor are also primary factors influencing to a great extent the quality of coal produced by a mine. If the floor happens to be a species of "black jack," which in the majority of cases does not possess a well defined cleavage surface between the coal bed proper and the floor, and the coal is either shot from the solid or the mining bench is unfavorably situated, making it necessary to shoot the coal both ways, it is invariably found that considerable of the black jack adheres to the coal, making the subsequent separation a laborious one. A few inches of shale may occur between the coal and the draw slate in the roof. The tendency of this slate when exposed to the air for a short time is to become friable and loose so that a slight jar may cause it to come down, bringing the draw slate with it.

The facts as cited above are not offered as an excuse for putting dirty coal on the market, but rather to emphasize the fact that coal as it comes to the tipple is bound to contain impurities which cannot be removed in any other way than by careful inspection.

Systems of inspection covering the principal features recommended by the writer are in operation at the mines of several of the large mining companies in the different coal regions. The following brief description covers the main items. The system as a whole is divided into two divisions,—mine inspection and tipple inspection, both of which are under the supervision of a chief inspector.

Mine Inspection.

The miners are carefully instructed by the mine superintendant and his assistants regarding the impurities such as shale, slate, black jack, sulphur bands, etc., that are to be discarded in loading the pit cars. These instructions are carefully enforced and penalties made against the miners violating same. The miner found loading dirty coal is notified that a second violation of these regulations will mean a penalty and that a third violation will mean discharge.

Tipple Inspection.

In operations where picking tables are not used the only recourse is to clean the coal as it passes from the chute into the railroad cars. At each tipple is permanently stationed an inspector who makes a daily report to the chief inspector on the number of cars loaded each day, the number and consignment of each car, together with the percentage of lump coal and the general conditions of coal loaded. This inspector has supervision over the slate pickers and regulates the rate of flow of coal from the coal chute into the railroad car. The chief inspector makes occasional visits to the different mines and sees that the inspection system is operating smoothly.

With a system of this kind put into effective operation it would seem that both the consumers and producers of coal would be equally benefited and that it would result in at least a partial elimination of the many complaints that are being made against coal operators for putting improperly prepared coal on the market.

Correspondence

Discussion on Previous Articles
Remuneration for Useful Ideas

ABOUT CERTIFICATES.

I was pleased to notice in the January number of The Power House, that the Stationary Engineers' Board of Ontario, have decided that on and after April 1, 1910, forms "B" and "C" will be discarded, and thereafter only the application form for examination will be accepted. And as you say that the purpose of this is to issue certificates only to those that pass an examination, I think that this is a wise move in the right direction.

The reference form which was presented to me by the board together with my papers, says this: A certificate will be granted without examination, (1) To every engineer who, at the time the act was passed (20th day of April, 1907) was in charge of a stationary steam plant in Ontario, of not less than 25 horse power, and who satisfies the board as to his character and sobriety. This part of the act, form "C," has done a great deal of harm to engineers in general. And it has also helped to keep down our pay, because before the act was passed, (viz. that any person not holding a certificate would not be allowed to operate a steam plant of 50 h.p. or over), anybody was allowed to handle steam plants, anybody who could shovel coal and turn on the injector, as one of our readers put it. This is one reason why engineers and firemen are so poorly paid, many of them having to work for less than $2 a day as Mr. Noble said in this issue of The Power House.

After the act was passed that every person in charge of a plant had to have a certificate, these men whom the employers had put to fire the boiler would be as much entitled to their papers (according to form C 3) as any qualified or experienced engineer.

Their papers would be handed out to them, and many of them (if you will allow me to use the expression) do not know a boiler from a load of hay. Just to illustrate what I mean I will tell you of a thing that occurred in this city.

One of these men that got their certificates because they were in charge of a plant when the act was passed, was on night duty, and some time during the night the gauge-glass exploded. Without staying to see what had occurred, he rushed to the phone, got his employer to get out of his bed, and told him to come down at once that the boiler had "busted." When his employer did come down, the place was flooded and of course all he had to do was to close the cocks, and put another glass in, which the certified engineer in charge, could not do. Another case was where the engineer on the night shift fell asleep, and let the water fall away down out of sight. When he awoke he said he put on the pump and ran for his life. But fortunately there was no explosion. We naturally ask how is it that these men come to be in possession of certificates? I am positive that they would never be able to pass the examination which I had to undergo. Simply because they were in charge of a plant before the act was passed, consequently according to form "C" were entitled to their papers. I think that every applicant for a certificate should have been examined in the first place, that is, when the act was passed, and thereby prove himself capable of handling a steam plant.

I also liked the suggestion of the representative deputation from the union, and C.A.S.E. To make the act respecting stationary engineers more applicable. In other words to enforce the act so as it will not only apply to power plants alone but to steam heating plants as well, operating at a pressure of ten pounds, because I know for a fact that, that 10 lbs. is oftener 60 lbs. than it is 10. I would like to suggest that an inspection be made of the factories (especially the smaller factories where anybody that has a little time to spare usually looks after the boiler) during the winter months, as a boiler that is in connection with a steam heating plant needs as much care as any other boiler. I think that all steam heating plants should be included in the act as suggested by the representatives of the union and C.A.S.E. And that the owners of such should be compelled by law to have a certified engineer in charge as a protection of life and property, and as means to raise the standard of our steam engineers.

G. J. PARRY.

CHANGING CUT-OFF.

How can the cut-off be changed from 1-5 to 1-4 on a Corliss engine without an indicator being used. M. C. S.

INJECTOR QUESTION.

I would also like some of our readers opinions on a very old problem, viz: How is it that a pump or injector working at a given pressure (say 100 lbs.) forces water into the boiler against the same pressure? I may say that this question is often given to young engineers as a catch question, especially when they are being examined by the board.

I may say that the action of an injector is usually attributed to the fact that the velocity of steam is greater than that of water. That the steam is led through a tapering nozzle with great force, into a chamber, causing a partial vacuum. As a vacuum cannot exist under ordinary circumstances, that is where there is water to do away with it, the water in this case naturally flows in. And it is further forced by the steam through what is known as the delivery jet which further increases its velocity.

Now the water gets as far as the overflow, and out it comes. And the reason that is usually given for this is that the pressure of the steam has been reduced. When it first passes into the injector probably, it loses some of its velocity in coming into contact with cold pipes, discs, nozzles, and jets, etc. Anyway it has either to come out at the overflow, or force itself against the same pressure that there is behind it, viz., 100 lbs. It naturally comes out at the overflow. But instantly it changes its course and instead of coming through this opening with nothing to obstruct it only a loose cap hanging check valve against a similar pressure of 100 lbs. How is this?

I would like some of our readers' opinions on this and the pump problem, which is the same thing.

G. J. PARRY.

USE OF COAL OIL, ETC.

My November issue of "The Power House" has just come to hand, and I will say a few words of what I think of "The Power House." For one thing, in publishing the Secret Commissions Act you are certainly doing every engineer in the province a great kindness, for I think lots of them have no idea they are breaking the law in accepting a commission from an oil man or one selling compounds or packing. It is time that agents obtained their business without having to stoop to such "tricks of the trade."

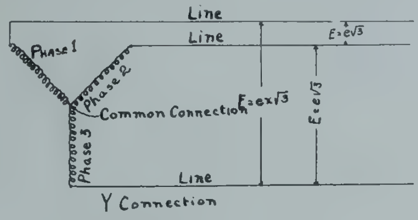
I see quite an article on page 45 of the November issue of "The Power House," signed "James Noble," on the use of coal oil in boilers. In 1894 I took charge of a steam plant some thirty-three miles east of Toronto. One of the boilers was 14x72, and it was very badly scaled. I cleaned it as well as I could when running, by blowing down one, and most of the time two gauges of water, cleaned it out every two weeks and used nothing but coal oil, and I got that boiler as clean as a new pin, right down to the iron. Likewise the inside of cylinder of engine was just as smooth as glass. This plant had been shut down for a long time. I was on that job for nearly three years and used no other kind of boiler purge.

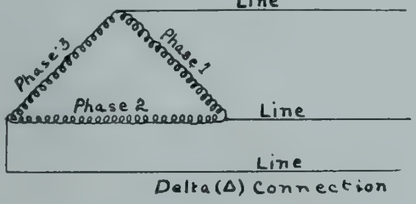
FRED NAGLE.

REPLIES TO IGNOTUS.

(1) Replying to some questions asked by Ignotus on electrical transmission, on page 42, February issue. A 16-candle power lamp requires 56 watts, and 2,500 lamps will use a total of 2,500×56=140,000 watts. A number 6 B & S wire will carry 65 amperes on open work. Ingnotus does not state what voltage he is using on the transmission line, but to make a No. 6 B & S carry power to supply 2,500 16 c.p. lamps, it is assumed that 2,000 volts is the pressure. Also the armature must be Y connected, as in the diagram shown. Then by the following formula, the current can be found for each of the three lines of No. 6 B & S. $C=\frac{W}{E\times\sqrt{3}}$, substituting the figures, we have $C=\frac{140{,}000}{2{,}000\times1.73}=\frac{140{,}000}{3{,}460}=$ 40.46 amperes in each wire, so that the No. 6 B & S would be safe to transmit the energy for 2,500 16 c.p. lamps. If a delta connection is used on the generator (as shown) the line current will be $C=c\sqrt{3}$; $C=40.46\times1.73=70$ amperes, and the voltage will be $\frac{E}{\sqrt{3}}=\frac{2000}{1.73}=1{,}156$ volts, and for a delta connection, a No. 6 would be too small. In the above formula the letters have the following meaning: C=line current, E=line voltage, W=total watts output, $\sqrt{3}=1.73$, c=current per phase.

(2) In a three phase three wire system, all the lines are the same size. No. 8 B & S wire will carry 46 amperes on open work. Transformers may be connected up in several ways on three phase circuits, depending on whether the Y, or delta connection is used. Assuming a ratio of 10 to 1, suppose the primaries are Y connected, the impressed voltage on each primary will be $\frac{2{,}000}{\sqrt{3}}=\frac{2{,}000}{1.73}=1{,}156$ volts. The secondaries are connected delta, and the voltage on the secondary line will be $\frac{1{,}156}{10}=115.6$ volts. So that by using a Y connection for the primary and delta connection for secondaries, the voltage is transformed from 2,000 volts to 115.6 volts. Ten k.w.=10,000 watts, and watts=$\sqrt{3}\times E\times C$. Transposing, $C=\frac{10{,}000}{1.732\times115.6}=$ 50 amperes on each line. So that at this voltage a No. 8 would be too small. If the voltage on the secondaries is 200 or over a No. 8 would carry 10 k.w. A No. 7 B & S would carry 10 k.w. at the voltage worked out. Of course, this is all assumption, as I do not know the full particulars of your plant.





(3) For house wiring, the fire underwriters do not allow anything less than a No. 14 B & S, except for flexible cord and fixtures. A No. 14 B & S will carry, on concealed work 12 amperes. 15 and 16 c.p. lamps require 15×.51=7.65 amperes, so that a No. 14 B & S is safe for 15 lamps. These calculations do not take into consideration losses in transmission, etc.

(4) As regards the rates, I could not say, perhaps some other readers could supply the information, on that point. The flat rate is used chiefly on hydroelectric plants, and the meter rate on steam plants.

In the hydro plants a flat rate is more suitable, because the charges are nearly all fixed, and also a hydro plant is different from a steam plant, in that they cannot go beyond the capacity of the water turbines. In a steam plant overloads can be carried for short periods to suit the demands made upon it, and is more flexible. For 125 customers for lights, I should say a meter rate would be the most suitable. A day service should pay if a good load can be obtained. The extra cost of giving a day service, would practically be the extra coal consumed for the day service, and extra wages for the day engineer. The following are some formulas by which Ingotus can do a few calculations for himself. They are for three wire three phase systems:—

W=watts output.
E=volts between lines.
e=volts generated per phase.
I=current in each line.
i=current in each phase.
$\sqrt{3}=1.732$.

For Y connections—
$E=e\sqrt{3}$.
$e=\frac{E}{\sqrt{3}}$.
I=i.

For delta connections—
E=e.
$I=i\times\sqrt{3}$.
$i=\frac{I}{\sqrt{3}}$.

For either a Y or delta connection and with a non-inductive load (all lights) the watts output, W=3×e×i, or W=$\sqrt{3}\times E\times I$. If the load is inductive (motors) W=$\sqrt{3}\times E\times I\times$cosine theata.

Thaeta=power factor.

Taking, W=$\sqrt{3}\times E\times I$, if watts and line voltage are known, the current for each line can be found by transposing for $I=\frac{W}{\sqrt{3}\times E}$; and $E=\frac{W}{\sqrt{3}\times I}$.

JOHN C. TWEEDALE.

BOILER COVERING.

I would like to receive through The Power House an answer to the following question : Which is the better boiler covering, common bricks and mortar, or plaster of paris ? Explain why ?

SUBSCRIBER.

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THE EDITOR IN CONFIDENTIAL MOOD.

We are constantly taking up questions in The Power House of interest to Canadian stationary engineers and power users. Ever since the beginning of The Power House we have kept in touch with the live questions and we are pleased to note that engineers from the Atlantic to the Pacific are showing, in a tangible way, their appreciation of our efforts.

Ontario engineers' certificates have been before the public for some time and the possibility of changes makes them still an interesting topic. The question of graded certificates is also a possibility in which engineers are interested.

Manitoba has had under discussion for the past year, a stationary engineers' act, based on that of Ontario, except that graded certificates have been introduced. This has not yet become law, but the question will probably be again discussed at the next sitting of the Legislature.

One problem that has interested the engineers, power users and manufacturers of boilers, is the securing of uniform boiler laws. These have been under discussion by the Engine and Boiler Section, and Engine and Thresher Section of the C. M. A. for some years. Alberta has recently brought about a new law, and now the different Governments are discussing uniform regulations for the several provinces, and through the aid of intelligent inspectors and mechanical engineers in the employ of the Provincial Governments, the changes will no doubt be brought about, so that a boiler acceptable in one province will be acceptable in any other province.

Another question in which the Canadian stationary engineer is interested, is "Smoke Abatement," on account of the many by-laws being enacted at the present time, and because of the economy that may be secured in endeavoring to secure the abatement of smoke. In this connection we have secured a number of excellent articles that will appear during the next few months. The article by Mr. Norris, that was to appear in the February issue, appears in this issue, and will no doubt be read with interest.

Canadian engineers can depend on The Power House keeping them in touch with all live Canadian questions in which they are interested. Besides, each month we endeavor to give articles by authorities on various subjects, which should appeal to the engineering fraternity.

It will, no doubt, be of interest to our thousands of Canadian readers, that engineers in the West Indies are also interested in the Canadian power paper. David Williams, one of the best known of our large staff or circulation representatives, has been visiting the West Indies for the past couple of months, and he writes that The Power House is taking well among the reading class of engineers and that all appear anxious to keep in touch with Canadian engineering practice.

Engineers have perused with interest our special issues and we have decided on several others, which will eclipse all our previous efforts. Many suggestions have been received from our readers in regard to to these and we have in preparation articles on certain subjects which will make them text books worth preserving for reference. The first of these "Specials" will be in April, when the subject treated will be "Power Transmission." About forty pages will be devoted to this subject, which should appeal to every engineer. Other subjects will be treated from time to time in a similar manner.

◆

COLD WATER DELUSION.

The aim of the stationary engineer is to secure the the "Cold Water Delusion," an explosion occurred in the Thetford Mines Hotel, on February 14, caused by a boiler being heated almost red hot, and then cold water being turned into it.

All the windows in the basement were blown out, and on the first floor several windows were broken, and even on the third floor, one guest's room door was blown open and his window blown out.

◆

"PUT THE BOILER UPSTAIRS."

The aim oif the stationary engineer is to secure the greatest economy with the conditions at command. People are harping on smoke abatement, and some engineers are really "up against it" to keep within the period of time prescribed by law. At a recent meeting of the Toronto Lodge, C.A.S.E., a paper was read on "Smoke Abatement" by Commissioner Harris. In the discussion that followed, it was pointed out that a better grade of coal was necessary in certain plants to secure smoke abatement.

It was also pointed out that while the present well-known stokers could be economically installed, the first cost was prohibitory in some small plants. There is a field for an inexpensive, efficient stoker for these small plants.

Sometimes a very small change in the conditions will secure the desired result of eliminating smoke emissions. It may be that there is an insufficient supply of air for the combustion of the fuel. For example; some times ago at the King Edward Hotel, Toronto, cinders and smoke were emitted from the chimney in large quantities, though stokers were in use. After making a study of the conditions, a fan of adequate capacity was attached to the furnace, thus eliminating further trouble and making it easy to keep within the prescribed six-minute period.

In some parts of the country a poor coal is available for power purposes. In such cases engineers have found a method of dealing with it. When there was a small supply of anthracite coal a few years ago, on account of strikes in the Pennsylvania district, it was impossible to keep the New York City power plant chimneys from emitting smoke. The furnaces were designed for anthracite and the poor quality of the Welsh coal which they were compelled to import and use, brought them constantly under the ban of the city by-law governing the emission of smoke.

Prof. Kent was consulted, and on examination of the conditions, remarked, "Put the boilers up-stairs." In other words, increase the combustion chamber. He recommended that for the poor-quality coal, the boilers be placed at twenty feet above the grates. The authorities were skeptical, and finally compromised at twelve feet. This boiler is still giving good service and burns poor-quality coal with excellent results.

This same principle has been advocated in Canada in order that a poor quality of coal may be burned and that there be little, if any, smoke, emission. In March, 1909, issue a Sarnia instalation was described where good results were obtained with soft slack coal by putting "the boiler up-stairs." In this case the distance between boiler and grates was fifty-one inches—less than six feet. Other instalations might be mentioned showing where more complete combustion was obtained by having a sufficiently large combustion chamber.

The question of smoke abatement has reached the council chambers, and engineers must be "on their job" every minute of the day if they are to keep within the limits of the by-laws. Anyway, for the sake of economy, every engineer should make a study of his plant and find out where improvements may be made. It is in this way that you can solve the problems for your employer and thus be invaluable to him.

◆

OIL SEPARATOR AS A MONEY-SAVER.

Touching the financial side of things in the power house, every piece of new equipment costs a certain amount as a first investment. If that new equipment yields an 8 or 10 per cent. on the investment it is well worthy of a place in the power plant. What would you think of an investment that yielded 20 or 25 per cent., or even more?

In many cases exhaust steam is condensed and used over and over again in the boiler. If the oil used to lubricate the cylinder is not properly removed it forms a greasy layer on the boiler plates, and lowers the heat transmission. A very thin layer of oil means a great loss of heat. A film of oil is as bad as a thick scale.

Recently experiments have been carried on in England to show how the layers of oil reduce conductivity. A thin film of oil was put on the inside and by carefully measuring the temperature on both sides of the boiler plate a difference of 79 degrees was shown. A thicker film of 1-16-inch was put on the inside and showed a difference of 179 degrees. A high flash oil was put on and there was a difference of 600 degrees.

This serves to show what a bad thing oil is. When a thin film of oil gathers on the boiler plate, it means this: More coal must be consumed to produce the steam. That is obvious. Now how many tons would require to be saved, to equal in price that of an oil separator. Figure it out and place the proposition before "the old man." He will see the point.

Oil is all right in its place and we cannot get along without it, but it isn't necessary in producing steam. It is an enemy of the boiler and every precaution should be taken to keep it out of the feedwater when exhaust steam is fed back to the boilers. Eliminate oil from boilers and reduce the coal bill.

◆

"ENGINEERING COMPANY. LIMITED."

The Ontario Gazette contains notice of incorporation of an "Engineering Company,"—"(a) To maintain and operate for gain places, shows or devices for providing exercise, recreation, amusement or entertainment; (b) To carry on a theatrical business, and (c) To carry on an hotel, restaurant and refreshment business." Probably the next incorporation will be "Engineering Company. Limited, (a) to operate a grocery business."

◆

ILLEGITIMATE SALESMANSHIP.

In spite of the rigorous provisions of the Secret Commissions Act, which prohibits the giving of secret rebates and commisions, there are still some salesmen who in their desire to get business are resorting to practices which are forbidden by the Act.

Our attention is frequently drawn to flagrant breaches of the Act and one of the most common practices in this regard appears to be the passing from the pocket of the salesman to the palm of the customer a sum of money sufficient to induce the latter to place an order for goods on which there is a fixed selling price.

Aside altogether from the moral aspect of such practices they are proofs of poor rather than good salesmanship. When a salesman resorts to secret rebates and other dishonest practices in order to secure business it is an acknowledgement of his own inefficiency to sell goods in the ordinary way.

The true salesman is he who relies upon the merits of his goods, plus his own personality, to effect sales; not he who is so unwise as to run the risk of incurring severe legal penalties in order to accomplish that which he cannot do by legitimate means.

One thing that perhaps can be said in favor of the salesman who is ready to break the law in order to effect a sale is that he is at least courageous in view of the fact that he is running the risk of a maximum penalty of a $2,500 fine or two years' imprisonment.

Those who have to substitute crookedness for efficiency should either learn the secret of true salesmanship or embark in some vocation in which dishonesty rules all actions.

Some day somebody will be caught, when there will be wailing and gnashing of teeth.

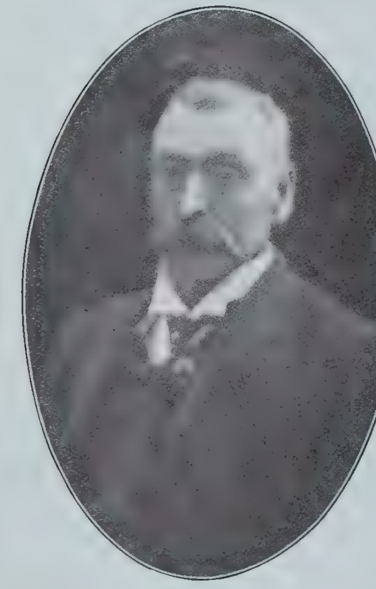
Annual Banquet of London Stationary Engineers

Third Annual Banquet on March 9, 1910, was a Big Success Both in Point of Attendance and Enthusiasm Manifested by Those Present.

The third annual banquet of the London No. 30 lodge, C. A. S. E., held in the Masonic Temple Banquet Hall, London, was another success to the credit of the London lodge. Under the chairmanship of the president, D. F. Campbell, every arrangement was made for the successful carrying out of the banquet, programme and toast list.

After an appetizing menu, the guests were entertained by some pleasing songs and interesting speeches. President Campbell was toast master. In proposing the toast to the King, he pointed out what the C. A. S. E. members were doing to educate themselves.

The Corporation of London was responded to by Mayor Beatty, who pointed out what London was doing for the education of its citizens. Workmen must be educated so they can read plans without running to their foreman to have it explained.



CHAS. E. KELLEY.

Chas. Kelley, executive president, entertained the guests with his Irish humorisms. He pointed out that the men in the smock and overalls with the hand on the throttle, were moving in the right direction to make their plants efficient. Engineers were exchanging ideas in the local lodges and were becoming more proficient in their duties. It gave a man a chance to learn and work up. In concluding Mr. Kelley extended a hearty welcome to the ladies to be present at the 1910 convention in Berlin, July 26, 27 and 28.

Manufacturers.

F. E. Leonard replied to the toast, "Our Manufacturers," and pointed out that the interests of the engineer and manufacturer are mutual. He then read a paper dealing with steam, gas and electric power.

"The Ladies" was responded to by Prof. Radcliffe of the London Normal School. "Sister Lodges" was responded to by W. G. Walters, Stratford, who pointed out that the interests of all the lodges was the assistance of brother engineers and in getting acquainted with new equipment and ideas for the power plant.

"Our Guests" was responded to by George Moll. G. C. Keith, editor of The Power House, Toronto, replied to the "Press." He referred to the press as the connecting link between technical education and the engineer. Through the press the engineer could learn from the experience of others; they could follow the questions of the day and keep in touch with developments in power plant equipment.

SOCIETY NOTES.

Executive President Chas. Kelley has opened up lodge 26 C.A.S.E., at Wallaceburg with 13 charter members.

A new lodge of the C.A.S.E. was recently opened at Arnprior by W. A. Crockett, executive secretary.

London Lodge, No. 30, held an open meeting on March 11, when Prof. Angus, professor in mechanical engineering at Toronto University, gave a lecture on Niagara Power Plants.

Wm. C. Brown, of the McDougall Caledonia Iron Works Co., Montreal, gave an illustrated lecture on turbine pumps in municipal work, before the mechanical section of the Canadian Society of Civil Engineers, Montreal, on March 10.

T. J. McKavanagh, chief electrician of the cable steamer Minia, read a paper on "Submarine Cables" before the Nova Scotia Society of Engineers, Halifax, on March 10.

The annual convention of the Canadian Electrical Association will be held at the Royal Muskoka, Lake Rosseau, July 6, 7 and 8. W. L. Adams of the Ontario Power Co., Niagara Falls, will act as chairman of arrangements and A. L. Mudge, of Smith, Kerry & Chace, Toronto, is chairman of papers committee; T. S. Young, Confederation Life Bldg., is secretary.

At a recent meeting of the Hamilton No. 2 Lodge, C. A. S. E., Jas. Crombie, manager of the boiler department of the Sawyer & Massey Co., Hamilton, read a paper on steam boilers. This paper is of interest to engineers generally, and is reproduced in this issue of The Power House

NORTHWEST ENGINEERS.

The following is the subject for the competition governing the competition for the prizes contributed by C. C. Snowdon, Calgary: "What are the greatest troubles that engineers have to contend with?" The following rules govern the contest:

1. All engineers in good standing of the Northwest Association of Stationary Engineers may compete for prize.
2. Essays to consist of not less than 300 words and not more than 500 words.
3. Competition will close April 1, all essays to be in by that date.
4. Essays to be addressed to J. E. Cullen, Box 41, Calgary.
5. Essays to be marked with motto and class of certificate only, name and motto of competitor to be enclosed in separate envelope and sealed.
6. Prizes to be presented at the last meeting in May, 1910.
7. The committee reserves the right to hold prize essays for publication.
8. Three prizes of equal value will be given, one to the best essay in each class, first, second and third.
9. "The Power House," 10 Front St. E., Toronto, to be judge, and judge's decision is final .

D. F. CAMPBELL.
President London No. 30 C.A.S.E.

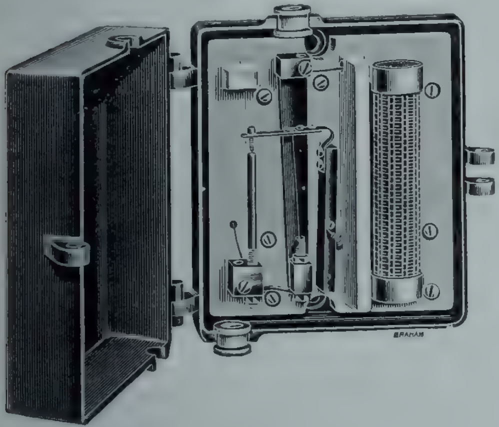
B. S. Mackenzie, C.E., of the Quebec Bridge Co., is leaving Montreal to accept the position as assistant engineer on the G.T.P., with headquarters in Winnipeg. He is a graduate of McGill University.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

THERMAL LIMITER.

In cases where light is paid on the "contract demand" system, it is necessary to include in the circuit a device which shall not only warn the consumer that he is exceeding his contract but which shall also make it impossible for him to continue to use light until he has reduced the demand to the agreed limit.



Thermal Limiter, Chapman & Walker, Toronto.

The action of the limiter is as follows: When the contract demand is exceeded by switching on an additional lamp, the extra current will cause the wire to expand and open the contact at the extremity of the spring. This puts a resistance into the circuit, thus dimming the lamps, and at the same time the wire cools, and closes the contact again. Thus the cycle of operations is repeated. The effect is to produce a continual flickering of the lights, which will of course cease when the additional light is switched off. A condenser is arranged across the gap to prevent any sparking which might otherwise ensue.

The Thermal Limiter is manufactured by Nalder Bros. & Thompson, London, England, for whom Chapman & Walker, corner Victoria and Lombard Sts., Toronto, are Canadian agents.

GETTING RESULTS FROM TUNGSTEN LAMPS.

There has been great progress in tungsten (mazda) lamp production during the past fifteen months. In the United States alone over 30,000 tungsten lamps are being shipped daily, and in Canada new factories are continually being added to the list of users.

The initial cost of the lamp is a little more than the ordinary lamp, but it takes so much less current that anyone's bills can be cut in half and the lamps pay for themselves many times over.

To secure the best results the tungsten lamp should be hung high, burning downward, protected from vibration. A tungsten lamp gives better satisfaction and lasts longer, if not used on a drop-cord. The tungsten lamp, of course, will burn wherever the carbon types are used, but by protecting it from jar better results are obtained.

The Tungstolier Co., of Canada, 96 King Street west, Toronto, are making a great number of instalations of their Tungstolier Units, which take up the jar and vibration, and prolong the life of the tungsten lamp, and give excellent results.

The Tungstolier Unit is designed especially for use of tungsten lamps, and is equipped with anti-vibratory and clevis arrangements to absorb all shocks and jars, thereby greatly increasing the life of the lamp and many times paying for the cost of a new fixture in lamp renewals.

The engineering department of the Tungstolier Co. will, without charge, lay out the lighting scheme for any place of business, factory, or office.

For commercial work it is possible to buy very simple fixtures, which are not artistic to any great degree, but are useful, practical, scientifically designed to elevate the lamps to the proper height, and to protect them by anti-jar suspension.

One Light Tungstolier.

The folding Tungstolier is the greatest revelation fixture practice has ever been through. The fixture is shipped completely wired and assembled, sockets and all. It is only necessary to make the connection at the ceiling. All that is required is a screw-driver, solder and a piece of tape. Folding Tungstoliers are packed one in a box, convenient for shipping and handling, economical in space.

The ordinary link fixtures which were first and formerly used by the manufacturers of the Folding Line Tungstolier, did not prove of sufficient protection to the tungsten lamp to justify its being adopted as a universal unit for the tungsten for factory use, and not until their anti-vibrating spring device, together with the many other anti-vibrating features in their Folding Tungstolier, was it thoroughly satisfactory to use the tungsten (Mazda) lamp in buildings where there was any vibration whatsoever.

The accompanying illustrations show Tungstoliers, completely assembled and wired. In addition to the spring attachment there are from two to eight anti-vibrating joints, depending on the style of the unit. Each of these retards vibration or jar. The Folding Tungstolier is made in one to six light units, and of different dimensions to comply with the requirements for correct illumination. Special scientific reflectors shown with the Tungstolier are used in connection with the fixture to give the best results for the work carried on in the artificial light. These are of special design, being the result of experiments carried on over periods of time. These reflectors and tungstoliers are being placed on the market by the Tungstolier Co. of Canada, Ltd., 96 King Street west, Toronto.

Tungstolier Showing Anti-Vibration Feature.

POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

British Columbia.

VANCOUVER—The Vancouver Power Co. purposes installing a 20,000 h.p. unit at its power works at Lake Buntzen. Already 33,000 h.p. is being developed there, the capacity being 60,000. With the growth of business, it is found necessary to instal something larger than the 10,000 h.p. units, the latest of which was only recently put in operation. The 20,000 h.p. unit will not be put in until next year, but verbal notification has been given the machinery supply men that they might get ready. The cost of everything in connection with the installation will be about $500,000. The Vancouver Power Co. is a subsidiary concern of the B.C. Electric Railway Co., which is also installing an auxiliary steam plant in this city. Eighteen carloads of boiler machinery have already arrived. In this plant will be a 4,000 h.p. turbine engine to be put in by the Allis-Chalmers-Bullock Co., and which will be the first of its kind in this province.

VANCOUVER.—The Canadian Brewing & Malting Co. will equip their plant with a 50-ton refrigerating machine, contract for which was let to the Arctic Ice Machine Co., Canton, Ohio.

VICTORIA.—The Pacific Coast Fisheries Co. has completed its new fish freezing and cold storage plant with excellent arrangement for handling by-products such as fish oil, fertilizer, etc., located at Pacofi, at head of Selwyn inlet, Moresby island. The cold storage house is a separate one-story building, 70 x 170 feet in area, having two freezing rooms and one glazing room. Ten tons of fish, it is stated, can be frozen and glazed per day, and there is cold storage for 600 tons. A 50-ton Linde refrigerating plant and 5-ton ice-making system are installed in the adjoining power house.

VICTORIA.—The Silverspring Brewery is making a number of improvements in its plant, including the addition of a 20-ton distilling apparatus for its ice-making plant, furnished by the Arctic Ice Machine Co., Canton, Ohio.

VICTORIA.—The Victoria Cold Storage & Ice Co. has been organized to take over and operate the plant of the B. Wilson Co., on Store Street. Extensive improvement, it is stated, will be made. F. Dickinson is to be manager.

Alberta.

CAMROSE.—This municipality is open until April 16 to receive propositions from companies or individuals for the installation of an electric light and power plant on a ten-year franchise basis. O. B. Olson, secretary-treasurer.

CALGARY.—The Calgary Water Power Co. have placed an order with the Robb Engineering Co., Amherst, N.S., for a 1,000 h.p. vertical cross compound condensing engine, complete with condenser, heater and pump. They have also placed an order with the Canadian Westinghouse Co., for a 600 k.w. alternating current generator, complete with exciter and switchboard.

EDMONTON.—An abattoir and cold storage plant to cost about $100,000 will be erected this year at Edmonton by a stock company now being organized and which includes among its stockholders retail meat dealers in this city and farmers and live stock raisers in the surrounding country, according to accounts published in the local newspapers.

MEDICINE HAT.—The Alberta Clay Products Co. will install a 500 h.p. power plant, consisting of three tubular boilers, Corliss engine, generator, pumps, heater, etc.

Saskatchewan.

PRINCE ALBERT.—It is reported that arrangements have been practically concluded for the establishment of a modern meat packing plant, with cold storage and freezing facilities, at Prince Albert. Between $50,000 and $100,000 is to be invested in the enterprise. The project is being promoted by J. F. MacKenzie, of Prince Albert.

WEYBURN.—Sealed tenders will be received by the Secretary-Treasurer of Weyburn, until 8 p.m. on Wednesday, April 27th, 1910, for the following works:—Contract "A"—Pipelaying on the sewerage system; Contract "B1"—Waterworks pump house; contract "B2"—Power House; contract "F"—Mechanical water filters; contract "G"—Waterworks pumping machinery; contract "S"—Sewer pipes; contract "W"—Furnishing wooden stave pipes; contract "X"—Sewage disposal works. Plans and specifications may be seen at the office of the Chief Engineer, Winnipeg and Toronto, and at the Town Hall, Weyburn. R. H. Smith, Esq., M.D., Mayor, Weyburn, Sask.; Geo. Ross, Esq., Secretary-Treasurer, Weyburn, Sask.; Willis Chipman, Chief Engineer, Winnipeg and Toronto.

Manitoba.

BRANDON.—The Municipal Light, Heat & Power Co., with head offices in Hamiota are opening a warehouse and manufacturing plant on the Great Northern Railway right-of-way just east of Eighteenth Street. It is their intention to erect a warehouse and factory building.

Ontario.

BOWMANVILLE.—It is announced that a Canadian Goodyear Tire & Rubber Co. has been formed, and that the factory will be located here. Branches will be opened in important centres, that in Toronto being at 85-87 Queen Street East. Mr. F. Hodgins, local manager.

FORT WILLIAM.—Bids, sealed and endorsed "Gas Franchise," will be received by the City Clerk of Fort William, up to April 1st, 1910, for the letting of a gas franchise, including construction of plant, mains, etc., and operation. Conditions, specifications and form of tender, on which bids must be submitted, can be obtained from John Wilson, assistant city engineer, Fort William, Ont.

FORT WILLIAM.—The Western Electric & Supply Co. has been incorporated to buy, own, sell and manufacture all kinds of gas and electrical supplies, apparatus and machinery and to carry on business as dealers in and manufacturers of gas and electrical supplies and as contractors in the furnishing and installation of gas and electrical supplies, apparatus and machinery and also to carry on the business of electricians.

GUELPH.—Municipal ownership of the gas, electric light and water plants of the city of Guelph show good results according to the reports presented to the council on Feb. 17 by the commissions. The gas output shows an increase of twelve per cent., and the revenue increased from $48,779.23 to $56,556.94 for the year, while the electric light plant shows an increase from $34,947.45 to $40,573.47. On the two departments the Light and Heat Commissioners report a gross profit of $40,319.13, after setting aside $5,000 for depreciation, interest $9,241.53, or $31,077.60 net gain, and a total income of $98,525.79, including $4,647 premium on debentures sold.

HAMILTON.—Lake Simcoe Ice & Cold Storage Co., Hamilton and Toronto, has filed certificate of increase of capital stock from $100,000 to $300,000.

HAMILTON.—The annual meeting of the Dominion Power & Transmission Co., was held on Feb. 21. The gross earnings of the various subsidiary companies amounted to $1,691,696.44, and the operating expenses to $963,949.06. After deducting interest, etc., the amount carried to profit and loss was $305,807.74, and this account now amounts to $653,767.10. The company owes the Dominion Government $13,000 for water taken from the Welland canal, and in future it will have to pay $30,000 a year. The following directors were re-elected: John R. Moodie, James Dixon, W. C. Hawkins, John Knox, J. W. Sutherland, William Southam, S. O. Greening and Lloyd Harris, Brantford. At a subsequent meeting Lieut.-Col. Moodie was elected president; James Dixon, vice-president; W. C. Hawkins, secretary, and John Knox, treasurer.

PETERBORO.—Expanding business has made it necessary for the Canadian General Electric Co. to enlarge its premises. Frederick Nicholls, general manager of the company, states that it is the intention to spend between $250,000 and $750,000 on new buildings and equipment.

ST. THOMAS.—The Council has awarded the contracts for installing the Niagara power to the Canadian Westinghouse Co. The company will install the machinery in five months' time for the sum of $18,000.

STIRLING.—The ratepayers will vote on a by-law to issue $10,000 twenty year 5 per cent. electric light debentures on March 21. G. G. Thrasher, town clerk.

TORONTO.—The Vilter Manufacturing Co., Milwaukee, Wis., builders of ice-making and refrigerating machinery, Corliss engines, etc., reports twenty-three recent orders, including ice machines from 4 to 150 tons capacity. Many of these machines are operated by their Corliss engines direct connected.

TORONTO.—Included in the supplementary estimates of the Provincial Treasurer are the following items: Electric plant, Hamilton Asylum, $12,000; electric plant, London Asylum, $25,000, and electric plant, Ontario Agricultural College, Guelph, $15,000.

TORONTO.—Siemens Bros. Dynamo Works, has been incorporated with Arthur S. Herbert as manager. They will carry on the business of electricians, contractors, mechanical engineers and dealers in electric and hydraulic supplies.

Quebec.

MONTREAL.—The Deaf and Dumb Institute is to be equipped with a 6-ton refrigerating plant, contract for which was let to the York Mfg. Co., York, Pa., U.S.A.

MONTREAL.—The St. Regis Hotel Co. will equip its hotel with a 4-ton refrigerating plant, furnished by the York Mfg. Co., York, Pa., U.S.A.

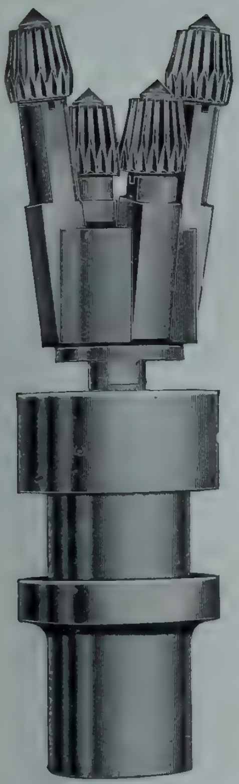
MONTREAL.—Ice dealers at Montreal were very much chagrined at the announcement early in January that the Quebec Provincial Government would secure legislation to restrict or prohibit ice harvesting within 25 miles of the city.

SHERBROOKE.—It is reported that the St. George Electric Co. will build a concrete dam and electric plant on the Chaudiere River, at a cost of $75,000. J. W. Gregoire is secretary.

Nova Scotia.

DARTMOUTH.—S. Chittick & Sons contemplate establishing an ice-making plant and are securing prices on machinery, etc.

NEW GLASGOW.—The council is considering plans for increased water supply at an estimated cost of $175,000.



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CYCLONE
TUBE CLEANER

Subdue Your Boiler Troubles

But don't attempt to do so without enlisting the aid of modern methods. Foremost among modern methods for the power plant are the

"Liberty"
Power Plant Appliances

"Liberty" appliances have found their way through sheer usefulness, into nearly all of the largest and most efficient power plants on the continent.

The presence of "Liberty" appliances in a boiler house indicates that the engineer in charge is provided with the most effective aids to efficient and economical power house management known to the mechanical world.

Are there any "Liberty" appliances in **your** power house?

It will give us great pleasure to forward, at your request, the complete "LIBERTY" CATALOG. Send for it. It will interest you immensely.

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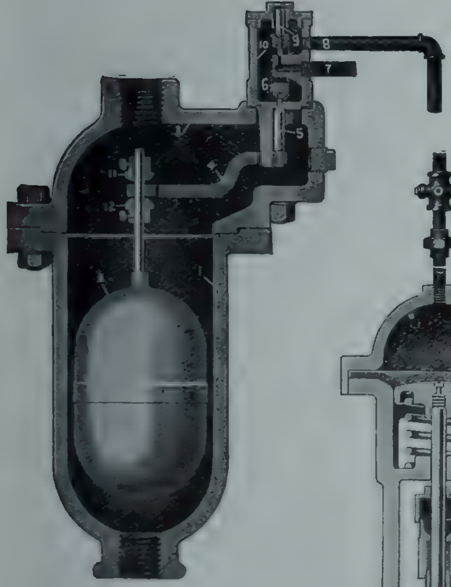
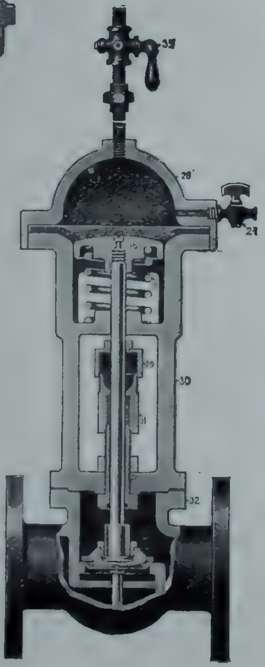
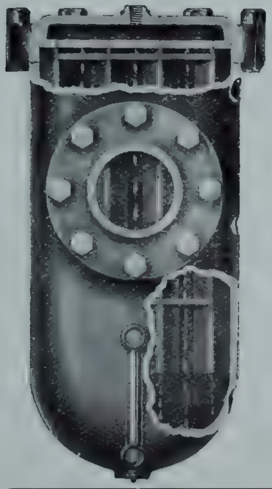
6902 Susquehanna St.,
PITTSBURG, PA.

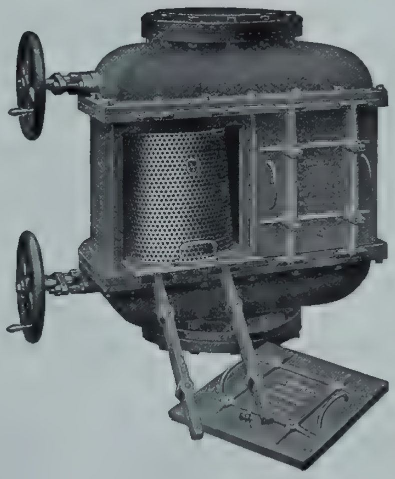


The "Liberty"
FEED WATER
REGULATOR



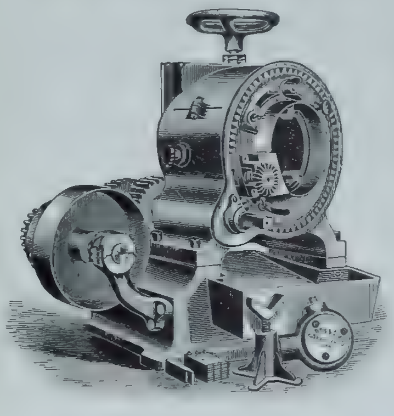


The
"Liberty-Greenaway"
Horizontal
OIL SEPARATOR



The "Liberty"
TWIN STRAINER

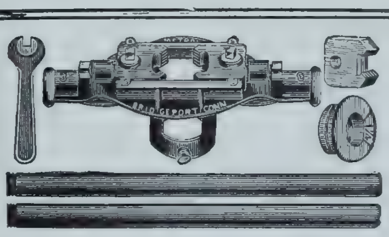
Cutting Pipe Threading Costs



It doesn't take long for the "Forbes" Pipe Threading and Cutting Machine to pay for itself. Its first cost is low, it works rapidly and it requires only one operator. Threads pipe up to 15 in. diameter. It's a simple, compact, durable machine, and requires very little room to operate in.

PARTICULARS?

THE CURTIS & CURTIS CO.
26 Garden Street,
BRIDGEPORT, - - CONN.



GENUINE ARMSTRONG STOCKS AND DIES FOR CUTTING PIPE & BOLTS ARE THE BEST.

PIPE MACHINES
PIPE CUTTERS
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RATCHET ATTACHMENTS

Manufactured by
THE ARMSTRONG MFG. CO.
298 Knowlton St.
BRIDGEPORT, CONN.
NEW YORK CHICAGO
Catalog mailed on request

U.S. AND BARKEEPERS FRIEND METAL POLISH
USED AND ENDORSED BY THE LEADING DEALERS
SOLD ALL OVER THE WORLD

G. T. P. Shops, Winnipeg.

Sealed tenders, addressed to the undersigned, and marked on the envelope "Tenders for Machines and Tools," "Tender for Leather Belting," etc., etc., as the case may be, will be received at the office of the Commissioners of the Transcontinental Railway, at Ottawa, Ontario, until 12 o'clock noon of the 12th day of April, 1910, for :

(1) Machines and tools ; (2) Leather belting ; (3) Shafting, hangers, steel frame work, etc. ; (4) Miscellaneous equipment, industrial track and lockers ; (5) Motors ; (6) Furnaces and forges ; (7) Cranes ; (8) Air compressors ; (9) Grey iron foundry equipment and brass foundry equipment; required for the equipment of the locomotive and other shops of the Commissioners of the Transcontinental Railway at Springfield, east of Winnipeg, Manitoba.

Tenders will be received and considered for any or all of the items indicated above and numbered from 1 to 9, both inclusive.

Plans and specifications may be seen in the office of the Chief Engineer of the Commissioners at Ottawa, Mr. Gordon Grant, and in the office of the District Engineer of the Commissioners at St. Boniface, Man., Mr. S. R. Poulin.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied by the Commissioners, which may be had on application to the Chief Engineer at Ottawa, or to the District Engineer at St. Boniface, Man.—P. E. Ryan, Sec'y of Commissioners.

Bergmann's Canadian Agency.

The Bergmann Electrical Works, Berlin, Germany, and with works in Austria and France, are introducing their tungsten lamp into the Canadian market through their representative, Dr. C. Rossner, who was for a time assistant secretary of the Montreal Trust Co., before taking the present position. If the business of the company shows sufficient growth branch works for the manufacture of the Bergmann tungsten lamp will be established in Canada. The recent alterations in the tariff arrangements between Canada and Germany means that the duty on tungsten lamps entering Canada from Germany will now be 30 per cent. instead of 40 per cent.

Prince Rupert Lighting Plant.

James Milne, M.E., 304 Loo Bldg., Vancouver, has been engaged to prepare plans and specifications for the lighting plant for Prince Rupert, B.C. Tenders will cover gas producer plant and also steam plant, the approximate cost being $60,000. The specifications will include 100 arc lights and it is expected that when the plant is ready for operation in September next there will be 6,000 lights in Prince Rupert.

Catalogues Wanted.

Arturo Hernadez, Havana, Cuba, has arranged to do all the purchasing for La Berlin, a large electrical concern in Havana who are contractors for many government and private installations, and he desires catalogues and literature in electrical lines. Mr. Hernandez is particularly interested in lighting electrical goods.

D. K. McLaren Belting Co. Enlarge.

D. K. McLaren Belting Co., Montreal, purchased the premises belonging to the clothing firm of H. Kellert & Son. The building is a four-storey solid brick structure with a concrete basement. It is a modern, up-to-date factory, warehouse and office building. The property has two frontages, one of 60 feet on St. James Street, and another of 60 feet on little Craig Street, the whole area being about 7,000 square feet, which will give the McLaren Co. about 35,000 square feet of floor space. Ib

CATALOGUES.

BELTING.—F. Reddaway & Co., Pendleton, Manchester, have issued a number of price lists dealing with "Black Duck" and "Camel" brand belting through their Canadian branch, 56 St. Frs. Xavier St., Montreal. These price lists give prices for single and double belting for various widths. They have also issued price lists of camel hair brake banding, linen fire hose, etc. Among the publications is a handsome one which is a souvenir of the Franco-British Exhibition, held in London, 1908. This is presented with the compliments of F. Reddaway & Co., to their friends. It is printed in French and English, giving views of the various buildings including the "Camel" pavilion erected by that company. This book is attractively arranged and printed making an interesting and useful souvenir.

MECHANICAL FUEL FEEDER.—W. H. Adams, 102 Nazareth St., Montreal, special sales agent for Eastern Canada for the Vulcan mechanical fuel feeder has issued a catalogue describing fully this type of stoker to aid in smokeless and economical combustion. This fuel feeder is manufactured by the Vulcan Furnace Co., Buffalo. A full description of the stoker is given with references to smoke, draft, grates, etc. Tables are also given showing factors of evaporation, efficiency and evaporation required per boiler horse-power.

ALTERNATING CURRENT GENERATORS.—Vandeleur & Nichols, Dineen Bldg., Toronto, Canadian representatives of Bruce Peebles & Co., Edinburgh, are mailing pamphlet No. 13A dealing with Peebles A. C. generators. Standard slow and medium speed alternators are dealth with, those described and illustrated are well designed, well constructed and have a good appearance. The catalogue will be mailed on request.

ELECTRIC BARGAINS

We have some GOOD, PRACTICALLY NEW, MOTORS GOING AT A SACRIFICE

We manufacture alternating and direct current motors in all sizes also sell Century single phase motors in all their sizes. Repairs promptly and cheaply performed.

JONES & MOORE ELECTRIC CO., Limited
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will **personally—practically** instruct a few ambitious, deserving, bright men on practical, actual, up-to-date **Drafting Room Work** at home, prepare and qualify them as first-class **experienced Draftsmen** and **Designers** for a salary **paying $100 to $150 per month.**

Instructions until competent, and **placed in position free.** Also complete high grade drawing outfit, with German Silver set of **Instruments worth $13.85 free this month. Don't** answer this unless you are ambitiously seeking success and willing to work for results.

Address CHIEF DRAFTSMAN, Div. 23
ENGINEERS EQUIPMENT CO. (INC.) CHICAGO, ILL.

CORRECT FACTORY LIGHTING

The TUNGSTOLIER system of illumination gives every factory manager, superintendent or engineer an opportunity of improving their lighting system, increasing their illumination and reducing their consumption of current.

Our staff is composed of lighting experts who are at your service, and we maintain an Illuminating Engineering Department which will gladly furnish Lighting Recommendations for your factory, store or office upon application. No charge for recommendations. Send us details of space to be lighted.

THE TUNGSTOLIER CO.
OF CANADA, LIMITED

96 KING ST. WEST, TORONTO.

BABCOCK & WILCOX, Limited

"B. & W." PATENT

Water Tube Boilers

WITH FURNACES FOR ALL CLASSES OF FUEL OR WASTE GASES

Highest Economy Absolutely Safe up to the Highest Pressure

Over 7,000,000 H. P. in Use

also

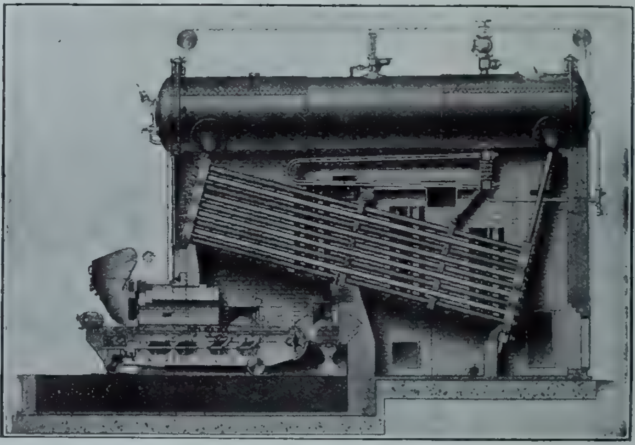
Steam Superheaters, Mechanical Stokers, Piping, Coal Handling Machinery, Steel Stacks, Feed Water Heaters, Water Softeners and Purifiers, Valves, Gauges, Accessories and Electric Cranes. : : :

COMPLETE POWER PLANTS DESIGNED AND INSTALLED

Sole Manufacturers in Canada of

"NEEMES" Patent SHAKING GRATES

Our Book "Steam" sent on request



Babcock & Wilcox Patent Water Tube Boiler Superheater and Mechanical Stoker

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To Our Readers,—Use this directory when seeking to buy power equipment or supplies. You will often get information that will save you money.

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To Non-Advertisers,—A nominal rate of $1 per line a year is charged non-advertisers.

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Nichols Chemical Mfg. Co., Montreal

Air Brakes.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Westinghouse Co., Hamilton

Air Compressors.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Jno. McDougall Caledonian Iron Works Co., Montreal

Air Chambers.

Hercules Float Works, Springfield, Mass

Air Receivers.

Jno. McDougall Caledonian Iron Works Co., Montreal

Air Vents, Automatic.

Canadian Steam Boiler Equipment Co., Toronto

Ammeters.

Canadian Westinghouse Co., Hamilton

Ammonia Fittings.

Vilter Mfg. Co., Milwaukee, Wis.

Antifriction Metal.

Magnolia Metal Co., New York, N.Y.

Arches, Boiler Door.

McLeod & Henry Co., Troy, N.Y.

Arches, Combustion Chamber

McLeod & Henry Co., Troy, N.Y.

Babbitt Metal.

Canada Metal Co., Toronto.
Magnolia Metal Co., New York, N.Y.

Bearings, Self-Oiling.

J. C. Wilson & Co., Glenora, Ont.

Belt Dressing.

Power Economy Co., Montreal

Belt Tighteners.

Waterous Engine Works Co., Brantford.

Belting, Leather.

Dominion Belting Co., Hamilton, Ont.
J. L. Goodhue & Co., Danville, Que.
J. D. McArthur, Brockville
D. K. McLaren, Ltd., Montreal.
Sadler & Haworth, Montreal.

Blowers.

W. H. Adams, 102 Nazareth St., Montreal, Que.
Power Economy Co., Montreal
Turbo-Blower Co., New York

Boiler Compounds.

Canadian Oil Companies, Toronto
Dearborn Drug and Chemical Works, Chicago, Ill.
Electric Boiler Compound Co., Guelph, Ont.
Hygienic Laboratories, Toronto
International Boiler Compound Company, Chicago
Nichols Chemical Co., Montreal
C. C. Snowdon, Calgary

Boiler Compound Feeders.

Hygienic Laboratories, Toronto
Michigan Lubricator Co., Detroit
Morehead Mfg. Co., Detroit, Mich.

Boiler Feed Pumps.

Canadian Steam Boiler Equipment Co. Toronto
Darling Bros., Montreal

Boiler Feed Regulators.

Bain & Mitchell, Montreal
Peiler & MacKenzie, Montreal
Power Economy Co., Montreal
Standard Engineering Co., Toronto.

Boiler Feed Water Regulators.

Power Economy Co., Montreal

Boiler Mountings.

Babcock & Wilcox, Montreal
Darling Bros., Montreal
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
Peiler & MacKenzie, Montreal
Standard Engineering Co., Toronto.

Boiler Settings.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Boiler Tube Cleaners.

Liberty Mfg. Co., Pittsburg
Michigan Lubricator Co., Detroit
Wm. B. Pierce Co., Buffalo
Power Economy Co., Montreal

Boilers.

Babcock & Wilcox, Montreal
Brownell Co., Dayton, Ohio.
Goldie & McCulloch Co., Galt.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jones Underfeed Stoker Co., Montreal.
E. Leonard & Sons, London, Ont.
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Standard Engineering Co., Toronto
Waterous Engine Works Co., Brantford.

Boilers, Horizontal Tubular.

Goldie & McCulloch Co., Galt.
Jno. Inglis Co., Ltd., Toronto
E. Leonard & Sons, London, Ont.
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
H. W. Petrie, Toronto.
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Boilers, Locomotive

Jno. Inglis Co., Ltd., Toronto
Goldie & McCulloch Co., Galt, Ont.

Boilers, Marine.

Babcock & Wilcox, Montreal
Goldie & McCulloch Co., Galt.
Jno. Inglis Co., Ltd., Toronto
E. Leonard & Sons, London, Ont.
Jenckes Machine Co., Sherbrooke, Que.
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Boilers, Vertical.

Goldie & McCulloch Co., Galt.
Jno. Inglis Co., Ltd., Toronto
H. W. Petrie, Toronto.
Jenckes Machine Co., Sherbrooke, Que.
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Boilers, Water Tube.

Babcock & Wilcox, Montreal
Polson Iron Works, Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.

Boosters.

Geo. C. Royce, West Toronto

Brine Coolers.

Vilter Mfg. Co., Milwaukee, Wis.

Canners' Machinery.

J. C. Wilson & Co., Glenora, Ont.

Cars, Transfer.

Corbet Foundry and Machine Co., Owen Sound

Castings, Brass.

Hercules Float Works, Springfield, Mass,
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
J. C. Wilson & Co., Glenora, Ont.

Cement Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal
Jno. McDougall Caledonian Iron Works, Montreal

Chemicals.

Dearborn Drug and Chemical Works Chicago
Nichols Chemical Mfg. Co., Montreal

Circuit-Breakers.

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Coal and Ash Conveyors.

Babcock & Wilcox, Montreal

Coal Handling Machinery

Standard Engineering Co., Toronto

Cold Storage Architects.

E. J. Greenstreet, Toronto

Condensers.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
J. P. Devine Co., Buffalo, N.Y.
Goldie & McCulloch Co., Galt.
Jno. Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Vilter Mfg. Co., Milwaukee, Wis.

Consulting Engineers.

Bain & Mitchell, Montreal
Bayfield & Archibald, Vancouver, B.C.
de Gaspe Beaubien, Montreal.
Rowland Brittain, Vancouver, B.C.
W. S. Brooke, Toronto
Cleveland & Cameron, Vancouver, B.C.
Dutcher & Foreman, Vancouver, B.C.
John T. Farmer, Montreal
Walter J. Francis, Montreal.
J. F. Frew, Vancouver, B.C.
Galt & Smith, Toronto.
E. J. Greenstreet, Toronto
John S. Isdale, Vancouver, B.C.
F. M. G. Johnson, Montreal
Laurie & Lamb, Montreal
Marchand & Donnelly, Ottawa, Ont.
Ralph D. Mershon, Montreal
C. H. & P. H. Mitchell, Toronto
Moore & Scollan, Toronto
John B. McRae, Ottawa
Morris Engineering Co., Vancouver, B.C.
J. M. Robertson, Montreal.
M. A. Sammett, Montreal.
J. M. Shanly, Montreal.
Standard Engineering Co., Toronto
F. J. L. Tytler, Vancouver, B.C.
Vancouver School of Engineering, Vancouver, B.C.
C. S. Youle, Victoria, B.C.

Contractors, Structural Steel

Corbet Foundry and Machine Co., Owen Sound

Conveyor Machinery.

Jno. McDougall Caledonian Iron Works, Montreal

Coppersmiths.

Hercules Float Works, Springfield, Mass.

Cork Insulation.

Linde British Refrigeration Co., Montreal

Couplings.

J. C. Wilson & Co., Glenora, Ont.

Cranes, Electric.

Babcock & Wilcox, Montreal
Jno. McDougall Caledonian Iron Works, Montreal

Crank Pins.

Michigan Lubricator Co., Detroit
Sight Feed Oil Pump Co., Milwaukee, Wis.

Cross Head Pins.

Michigan Lubricator Co., Detroit
Sight Feed Oil Pump Co., Milwaukee, Wis

Crushing Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal

Damper Regulators.

Darling Bros., Montreal
Julian d'Este Co., Boston, Mass.
Peiler & MacKenzie, Montreal
Standard Engineering Co., Toronto

Dredges.

Allis-Chalmers-Bullock, Ltd., Montreal

Drills, Rock.

Allis-Chalmers-Bullock, Ltd., Montreal

Drying Machinery.

J. P. Devine Co., Buffalo N.Y.
Jno. Inglis Co., Ltd., Toronto

Dynamos.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Mechanical & Elec. Lab., Buffalo
Electrical Maintenance & Repair Co., Toronto.
Jones & Moore Electric Co., Toronto.

Economizers.

Babcock & Wilcox, Montreal

Electric Power Instalations.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Jones & Moore Electric Co., Toronto
Kilmer & Pullen, & Burnham, Toronto
Packard Electric Co., St. Catharines.

Electrical Accessories.

Canadian Westinghouse Co., Hamilton
Chapman & Walker, Toronto

Electrical Machinery.

Canadian Westinghouse Co., Hamilton
Chapman & Walker, Toronto

Electrical Repairs.

Canadian Electrical & Motor Co., Toronto
Electrical Maintenance & Repair Co., Toronto.
Jones & Moore Electric Co., Toronto
Northern Electric Supply Co., Orillia, Ont.

Elevating Machinery.

Goldie & McCulloch Co., Galt.
Waterous Engine Works Co., Brantford.

Engines, Automatic.

E. Leonard & Sons, London, Ont.
H. W. Petrie, Toronto.
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.

Engines, Corliss.

Allis-Chalmers-Bullock, Ltd., Montreal
Goldie & McCulloch, Co., Galt.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Vilter Mfg. Co., Milwaukee, Wis.

Engines, Gas and Gasoline.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Colonial Engineering Co., Montreal
Drummond, McCall & Co., Montreal
Dymond Gas & Engine Co., Toronto
Fielding & Platt, Ltd., Gloucester, Eng.
Goold, Shapley & Muir Co., Brantford
Jno. McDougall Caledonian Iron Works, Montreal
W. H. Oliver & Co., Toronto.

Engines, High Speed, Steam.

Brownell Co., Dayton, Ohio
Goldie & McCulloch Co., Galt.
Jno. McDougall Caledonian Iron Works, Montreal
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Engines, Marine

Jno. Inglis Co., Ltd., Toronto

Engines, Medium and Low Speed.

Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Saw Mill.

Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
E. Leonard & Sons, London, Ont.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Engines, Single, Compound and Triple Expansion.

Brownell Co., Dayton, Ohio
Drummond, McCall & Co., Montreal
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal
Jno. McDougall Caledonian Iron Works, Montreal
E. Leonard & Sons, London, Ont.
Kerr Engine Co., Walkerville
Robb Engineering Co., Amherst. N.S.
Waterous Engine Works Co., Brantford

Engines, Slide Valve

Jno. Inglis Co., Ltd., Toronto

Engines, Vertical.

Robb Engineering Co., Amherst, N.S.
Jno. McDougall Caledonian Iron Works, Montreal
H. W. Petrie, Toronto.

Exhaust Heads.

Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
Standard Engineering Co., Toronto.
Watson & McDaniel Co., Philadelphia

Feed Water Alarms.

Reliance Gauge Column Co., Cleveland, Ohio

Feed Water Analyser.

Dearborn Drug and Chemical Works, Chicago

Feed Water Heaters

Babcock & Wilcox, Montreal
Canadian Steam Boiler Equipment Co., Toronto
Brownell Co., Dayton, Ohio
Darling Bros., Montreal
Goulds Pump Co., Montreal.
C. Jacobs & Co., Boston, Mass.
E. Leonard & Sons, London, Ont.
Peiler & MacKenzie, Montreal
Robb Engineering Co., Amherst, N.S.
Standard Engineering Co., Toronto

Feed Water Regulators

Liberty Mfg. Co., Pittsburg, Pa.
Power Economy Co., Montreal

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Jno. McDougall Caledonian Iron Works, Montreal

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Harbison-Walker Refractories Co., Pittsburg, Pa.
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Flanges

Dart Union Co., Toronto

Flumes, Steel.

Corbet Foundry and Machine Co., Owen Sound

Furnace Linings.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Fuses.

Geo. C. Royce, West Toronto

Gas Producer Linings.

Harbison. Walker Refractories Co., Pittsburg, Pa.

Gas Producer Plants.

Bain & Mitchell, Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Colonial Engineering Co., Montreal
Drummond, McCall & Co., Montreal
Dymond Gas & Engine Co., Toronto
Fielding & Platt, Ltd., Gloucester, Eng.
Gas & Electric Power Co., Toronto.
W H. Oliver & Co., Toronto

Gauge Cocks.

Reliance Gauge Column Co., Cleveland, Ohio

Gauges, Pressure, Vacuum and Recording.

Babcock & Wilcox, Montreal
Lunkenheimer Co., Cincinnati, Ohio
Peiler & MacKenzie, Montreal

Gears, Angle.

Jno. McDougall Caledonian Iron Works, Montreal
J. C. Wilson & Co., Glenora, Ont.

Gears, Cut.

J. C. Wilson & Co., Glenora, Ont.

Gears, Mortise.

J. C. Wilson & Co., Glenora, Ont.

Gears, Reducing

Jno. McDougall Caledonian Iron Works, Montreal

Gears, Worm.

J. C. Wilson & Co., Glenora, Ont.

Generators.

Allis-Chalmers-Bullock, Montreal
Canadian Electrical & Motor Co., Toronto
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Jones & Moore Electric Co., Toronto
Kilmer, Pullen, & Burnham, Toronto.
Packard Electric Co., St. Catharines.

Governors.

Allis-Chalmers-Bullock, Ltd., Montreal
E. Leonard & Sons, London, Ont.

Governors, Water Wheel.

J. C. Wilson & Co., Glenora, Ont.

Grates.

Babcock & Wilcox, Montreal
Butterworth Foundry Co., Ottawa
Canadian Steam Boiler Equipment Co. Toronto
Diamond Grate Bar Co., Berlin, Ont.
Power Economy Co., Montreal

Gravity Closing Ventilators.

Standard Engineering Co., Toronto.

Grease Cups.

Detroit Lubricator Co., Detroit.
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
Peterboro Lubricator Mfg. Co., Peterbore
Power Economy Co., Montreal

Grease and Oil Extractors.

C. Jacobs & Co., Boston, Mass.

Greases

Canadian Oil Companies, Toronto
Electric Boiler Compound Co., Guelph, Ont.

Hangers.

Goldie & McCulloch Co., Galt.
Jno. McDougall Caledonian Iron Works, Montreal
Waterous Engine Works Co., Brantford
J. C. Wilson & Co., Glenora, Ont.

Head Protectors.

Vinton Co., New York, N.Y.

Heaters.

Darling Bros., Montreal
Goldie & McCulloch Co., Galt.
E. Leonard & Sons, London, Ont.

Hydraulic Accumulators.

Jno. McDougall Caledonian Iron Works, Montreal

Hydraulic Machinery.

Jno. McDougall Caledonian Iron Works, Montreal
Kent Co., Montreal

Ice Making Machinery.

Kroeschell Bros. Ice Machine Company, Chicago
Linde British Refrigeration Co., Montreal
Vilter Mfg. Co., Milwaukee, Wis.

Indicators, Electric—All Types.

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Indicators, Steam Engine.

Peiler & MacKenzie, Montreal
Jas. L. Robertson & Sons, New York.

Indicators, Water.

Detroit Lubricator Co.. Detroit

Injectors.

Detroit Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati, Ohio
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Insulating Papers.

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Insulation, Corkboard.

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Lamps, Arc.

Canadian Westinghouse Co., Hamilton

Lamps, Incandescent

Canadian Westinghouse Co., Hamilton
Chapman & Walker, Toronto
Packard Electric Co., St. Catharines

Lead Wool.

John Garde & Co., Toronto.

Lubricators, Force Feed.

Darling Bros., Montreal
Detroit Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
Sight Feed Oil Pump Co., Milwaukee, Wis.
Sterling Lubricator Co., Rochester, N.Y.

Lubricators, Plain.

Detroit Lubricator Co , Detroit

Maple Cogs.

J. C. Wilson & Co., Glenora, Ont.

Mechanical Stokers.

Babcock & Wilcox, Montreal
Jones Underfeed Stoker Co., Montreal.
Standard Engineering Co., Toronto

Meters, Electric

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Meters, Water

Drummond, McCall & Co., Montreal
Peiler & MacKenzie, Montreal

Mill Machinery.

Allis-Chalmers-Bullock, Ltd., Montrea
Goldie & McCulloch Co., Galt.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
Madison Williams Mfg. Co., Lindsay, Ont
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co.. Brantford
J. C. Wilson & Co., Glenora, Ont.

Mining Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal
Jno. Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

Motors.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Electrical & Motor Co., Toronto
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Electrical Maintenance and Repair Co. Toronto.
Jones & Moore Electric Co., Toronto
Kilmer, Pullen, & Burnham, Toronto.
Packard Electric Co., St. Catharines.

Motor Controllers.

Canadian Westinghouse Co., Hamilton

Motor Starters.

Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Geo. C. Royce, West Toronto

Oilers, Gang.

Michigan Lubricator Co., Detroit
Sight Feed Oil Pump Co., Milwaukee, Wis

Oilers, Multiple.

Detroit Lubricator Co., Detroit

Oil Filters

Darling Bros., Montreal
Liberty Mfg. Co., Pittsburg, Pa.
Power Economy Co., Montreal

Oil and Waste Saving Machines.

Canadian Oil and Waste Saving Machine Co., Brockville, Ont.

Oil Separators.

Babcock & Wilcox, Montreal
Canadian Steam Boiler Equipment Co., Toronto
Darling Bros.. Montreal
C. Jacobs & Co., Boston, Mass.
Liberty Mfg. Co., Pittsburg
Peiler & MacKenzie, Montreal
Power Economy Co., Montreal
Standard Engineering Co., Toronto

Oils, Lubricating.

Canadian Oil Companies, Toronto
Dearborn Drug and Chemical Works, Chicago
Electric Boiler Compound Co., Guelph Ont.

Packing, Leather.

Detroit Leather Specialty Co., Detroit
Electric Boiler Compound Co., Guelph, Ont.
Garlock Packing Co., Hamilton

Packing, Metallic.

Power Economy Co., Montreal

Panels, Electric

Hill Electric Switch Co., Montreal

Penstocks.

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Pipe Threading Tools.

Borden-Canadian Co., Toronto.
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Jno. McDougall Caledonian Iron Works, Montreal

Pipes, Water.

Pacific Coast Pipe Co., Vancouver, B.C.

Piping, Steam,

Babcock & Wilcox, Montreal
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Planimeters.

Peiler & MacKenzie, Montreal
Jas. L. Robertson & Sons, New York.

Plate Work.

Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford

Polish, Metal,

G. W. Hoffman, Indianapolis

Power Pumps.

Darling Bros., Montreal
Drummond, McCall & Co., Montreal
Goldie & McCulloch Co., Galt.
Goulds Pump Co., Montreal.
Waterous Engine Works Co., Brantford

Power Transmission Machinery.

Goldie & McCulloch Co., Galt.
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Waterous Engine Works Co., Brantford.
J. C. Wilson & Co., Glenora, Ont.

Presses, Hydraulic

Jno. McDougall Caledonian Iron Works, Montreal

Processing Retorts.

J. C. Wilson & Co., Glenora, Ont.

Pulleys.

Jno. McDougall Caledonian Iron Wor Montreal
J. C. Wilson & Co., Glenora, Ont.

Pumping Engines.

Jno. Inglis Co., Ltd., Toronto

Pulp Mill Machinery.

Jno. McDougall Caledonian Iron Works, Montreal

Pumping Machinery.

Allis-Chalmers-Bullock, Ltd., Montrea
Drummond, McCall & Co., Montreal
Jno. Inglis Co., Ltd., Toronto

Pump Governors.

Canadian Steam Boiler Equipment Co. Toronto
Darling Bros , Montreal
Julian d'Este Co., Boston, Mass.
Liberty Mfg. Co., Pittsburg, Pa.
Peiler & MacKenzie, Montreal
Standard Engineering Co., Toronto.
Watson & McDaniel Co. Philadelphia

Pump Strainers.

Canadian Steam Boiler Equipment Co., Toronto
Liberty Mfg. Co., Pittsburg, Pa.
Power Economy Co., Montreal

Pumps, Air,

Lunkenheimer Co., Cincinnati, Ohio

Pumps, Centifrugal

Jno. Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

Pumps, Geared

Jno. Inglis Co., Ltd., Toronto

Pumps, Oil.

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Michigan Lubricator Co., Detroit
Sight Feed Oil Pump Co., Milwaukee, Wis
Sterling Lubricator Co., Rochester, N.Y

Pumps, Steam

Jno. McDougall Caledonian Iron Works Montreal

Recorders.

Drummond, McCall & Co., Montreal

Refrigerating Engineers.

E. J. Greenstreet, Toronto

Refrigeration Machinery.

Kent Co., Montreal
Kroeschell Bros. Ice Machine Company, Chicago
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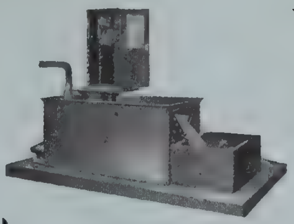

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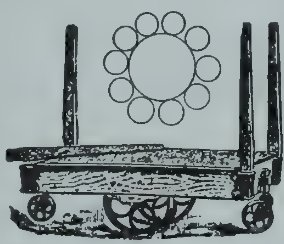

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Power Economy Co., Montreal
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Jas. Morrison Brass Mfg. Co., Toronto.
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Penberthy Injector Co., Windsor.
Power Economy Co., Montreal
Standard Engineering Co., Toronto.
Watson & McDaniel Co., Philadelphia

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Morehead Mfg. Co., Detroit, Mich.
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Erie Foundry Co., Erie, Pa.

Strainers.

Liberty Mfg. Co., Pittsburg, Pa.
Power Economy Co., Montreal

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Hill Electric Switch Co., Montreal

Superheaters, Steam,

Babcock & Wilcox, Montreal

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Chapman & Walker, Ltd., Toronto
Electrical Maintenance and Repair Co. Toronto.
Hill Electric Switch Co., Montreal
Geo. C. Royce, West Toronto

Switches.

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Tanks, Blow-off

Darling Bros., Montreal

Tanks, Oil.

Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
E. Leonard & Sons, London, Ont.
Sight Feed Oil Pump Co., Milwaukee, Wis.
Waterous Engine Works Co., Brantford.

Tanks, Steel.

Corbet Foundry and Machine Co., Owen Sound
Jno. Inglis Co., Ltd., Toronto

Tanks, Water.

Jno. McDougall Caledonian Iron Works, Montreal
Pacific Coast Pipe Co., Vancouver, B.C.

Tests and Inspections.

Bain & Mitchell, Montreal

Transformers.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Geo. C. Royce, West Toronto

Transmission Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal
Goldie & McCulloch Co., Galt, Ont.
Jno. McDougall Caledonian Iron Works, Montreal
Waterous Engine Works Co., Brantford.

Trucks, Dry Kiln.

Corbet Foundry and Machine Co., Owen Sound, Ont.

Trucks, Factory.

Corbet Foundry and Machine Co., Owen Sound
Jno. Inglis Co., Ltd., Toronto

Tube Cleaners.

Liberty Mfg. Co., Pittsburg, Pa.
Power Economy Co., Montreal

Tubes, Boiler,

Babcock & Wilcox, Montreal

Turbine Water Wheels.

Allis-Chalmers-Bullock, Ltd , Montreal
Chas. Barber & Sons, Meaford, Ont.
Jenckes Machine Co., Sherbrooke, Que.
The Madison Williams Mfg. Co., Lindsay, Ont.
J. C. Wilson & Co., Glenora, Ont.

Turbines, Steam.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Drummond, McCall & Co., Montreal
Dymond Gas & Engine Co., Toronto

Unions

Dart Union Co., Toronto
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit

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Vacuum Governors.

Canadian Steam Boiler Equipment Co., Toronto

Vacuum Pans.

J. P. Devine Co., Buffalo, N.Y.

Vacuum Pumps.

Canadian Steam Boiler Equipment Co., Toronto
J. P. Devine Co., Buffalo, N.Y.

Vacuum Regulating Valves.

Canadian Steam Boiler Equipment Co. Toronto
Darling Bros., Montreal
Peiler & MacKenzie, Montreal
Standard Engineering Co., Toronto

Vacuum Traps.

Morehead Mfg. Co., Detroit, Mich.

Valve Reseating Machines

Darling Bros., Montreal

Valves.

Canadian Steam Boiler Equipment Co Toronto
Detroit Lubricator Co., Detroit
Drummond, McCall & Co., Montreal
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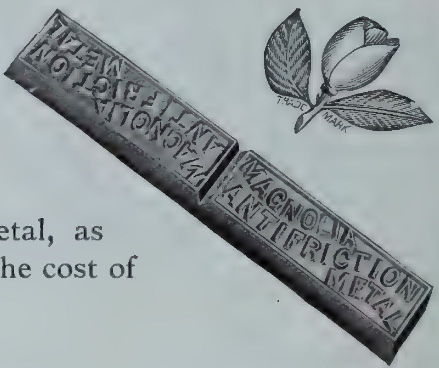

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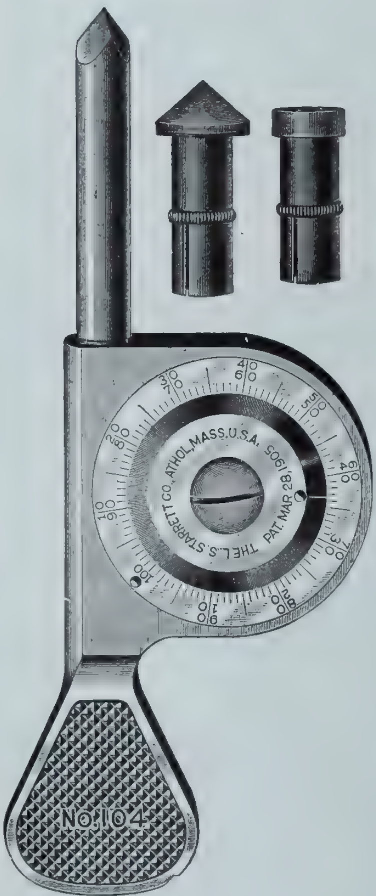
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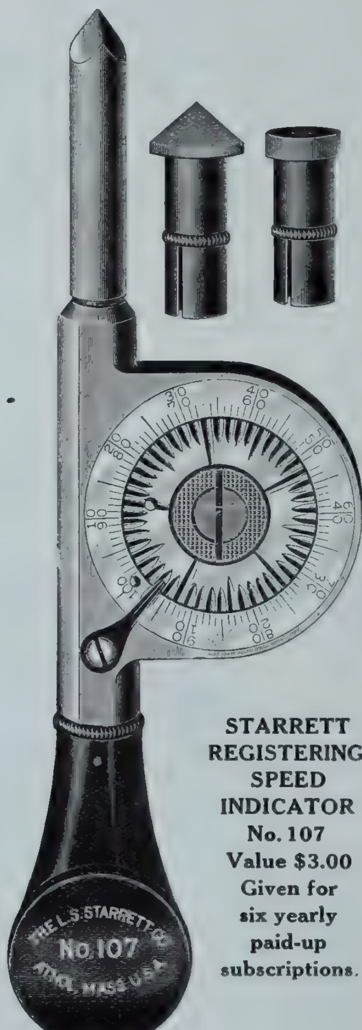
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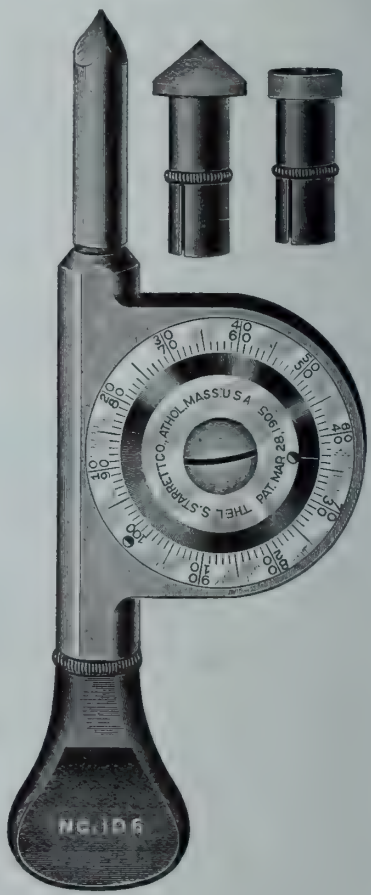
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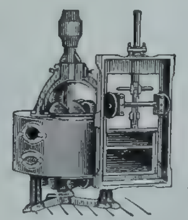

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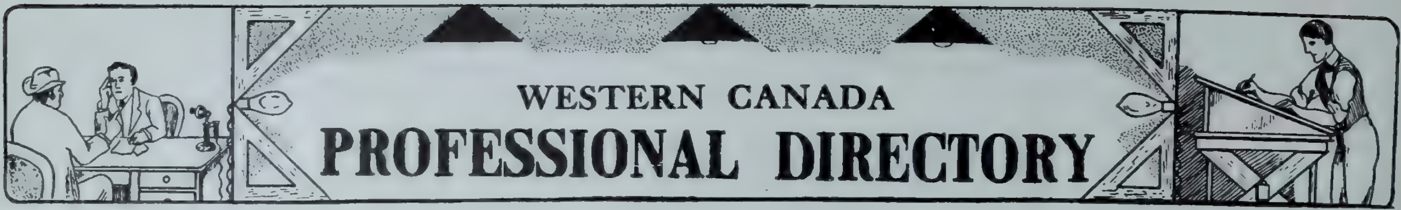

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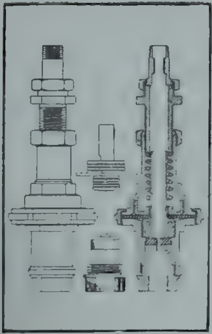


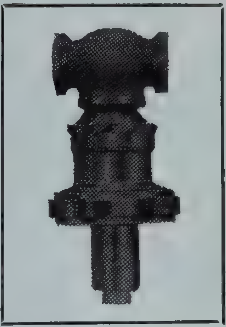
REDUCTION VALVE
for water, steam or air
Patent applied for

Engineers! Attention!

Keep cool! Don't worry your employer! Make your fireman look pleasant! How to do this! Use

W. H. Bice's Steam Appliances

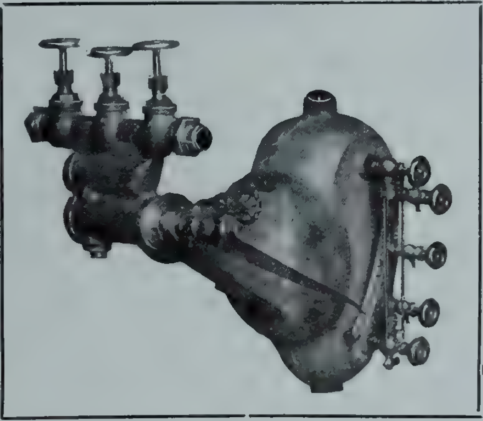
which keep water at given level, give dry steam, save fuel and make employer and fireman glad. Write for testimonials and price list.



PUMP GOVERNOR
Patent applied for

Manufactured by

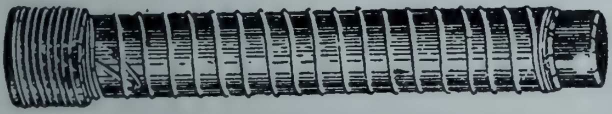
Automatic Feed and Regulator Company



FEED WATER REGULATOR. Patented Feb. 1st, '10.

100 Masonic Temple

London, Ontario



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For city and town Water Systems, Fire Protection, Power Plants, Hydraulic Mining, Irrigation, etc. One-half the cost of Iron Pipe—and better.

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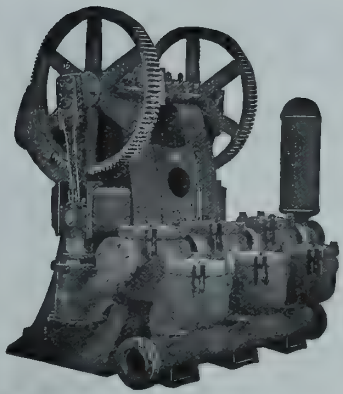

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Goulds Efficient Power Pumps

are growing in favor wherever they are installed. Let us send you catalog of Pumps for every service.

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Emil Passburg System

Vacuum Drying and Impregnating

Dries and Impregnates electric cables, dynamo and motor armatures, field and magnet coils, etc. Impregnating compound enters the vacuum chamber without breaking the vacuum, thus eliminating the possibility of the dried coils re-absorbing moisture. The most economical and satisfactory Drying and Impregnating process known to science.

All sizes and types. Write us for complete catalog

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POWER USERS, ENGINEERS OR CENTRAL STATION MEN wanting the name and address of the manufacturer of any class of power equipment, whether for steam, gas, or electric plants, will be able to obtain same by writing to the Editor of this journal. .:. .:. .:. .:.

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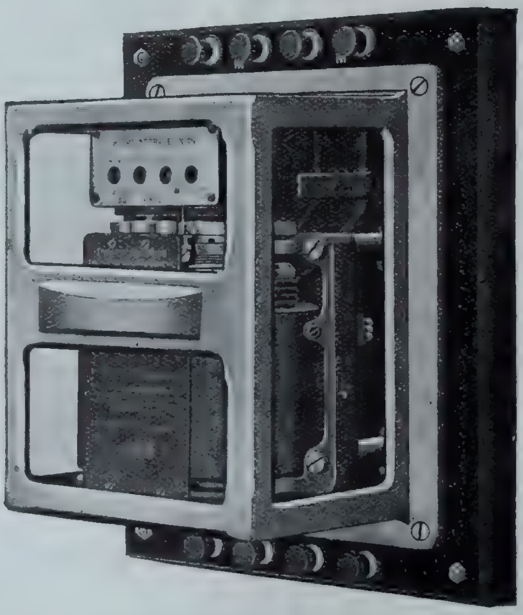
COMPLETE SWITCH BOARDS AND APPLIANCES

The Ferranti Meter fills all requirements.

Are known and sold the world over.

Remember, we manufacture a full and complete line of Switch Board Instruments, also furnish complete Boards, both High and Low Tension. : : : : :



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The Ferranti Leads!

"Why"?

It has a low starting current, accurate from 1/20 to 50% overload.

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No wear nor friction.

Send for our prices before purchasing. They will interest you.

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Send your burned out lamps to us and we make them as good as ever, perhaps better, and for much less than first cost.

PROVE OUR LAMPS

by sending an order right now, before you forget, and ship your old lamps to us when you have a fair quantity.

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Expert Lamp Renewers

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KERR GATE VALVES

are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

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Walkerville, - Ontario

With an Intercommunicating Telephone System

YOU simply press a button, put the receiver to your ear and—there's your man **talking** to you.

How often each day do you have to talk to others around your office—how many minutes — steps—would such an office—or factory—phone system save you?

You figure it out—you're the man who knows best—go into it with a pad on your own desk right now.

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Write for Bulletin No. 3113 if you are interested. We'll gladly send it FREE.

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A

Westinghouse

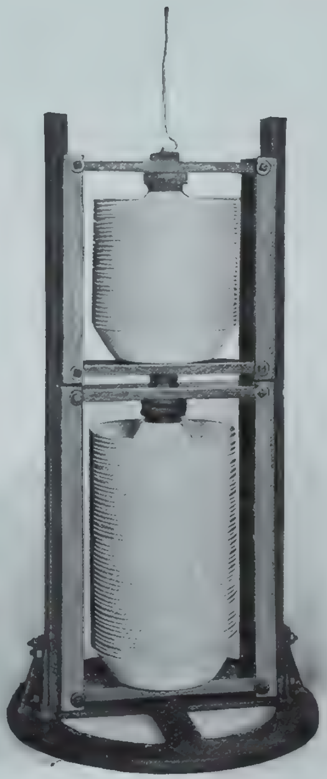
Type "A" Electrolytic Lightning Arresters

For Alternating Current Circuits---2206 to 120,000 Volts

Construction

--- A series of nested aluminum trays, supported and secured in frames of specially treated wood, and containing a tank of welded sheet steel, comprise the two essential parts of Westinghouse Type A. Electrolytic Arrester.

The aluminum trays are filled with electrolyte and lowered into place in the steel tank, which in turn is filled with transformer oil to within a few inches of the top. The oil furnishes insulation to the arrester as well as preventing evaporation of the electrolyte and also acts as a cooling medium in operation.

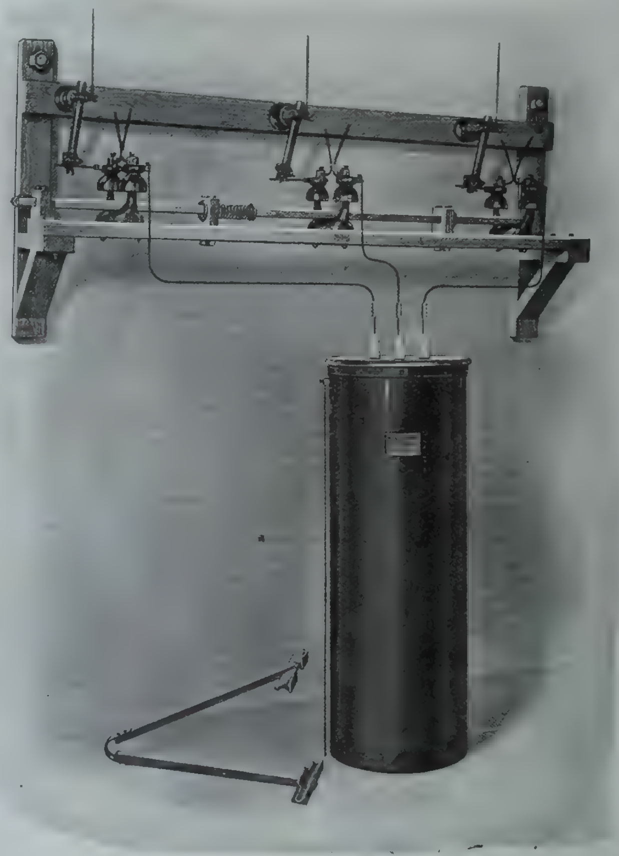


Guides with two tray sections in place.

Action

When the voltage reaches a predetermined voltage point, the film on the aluminum trays breaks down into myriads on minute punctures, short circuiting the potentials above the critical point and offering a free path to ground. When the discharge reduces the tension to normal, the punctures immediately seal up and the original resistance is restored.

The critical voltage of any tray having a fixed value, it is possible by connecting trays in series, to provide collective resistance to any desired degree. The action of the arrester is similar to that on a safety valve on a boiler. FOR FURTHER PARTICULARS ASK FOR CIRCULAR No. 1132.



Westinghouse Type "A" Electrolytic Arrester Installed, 7000 Volts Maximum—3-Phase.

Canadian Westinghouse Co., Ltd.

General Offices: Hamilton, Canada

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TORONTO	**MONTREAL**	**HALIFAX**	**WINNIPEG**	**CALGARY**	**VANCOUVER**

To the **Central Station Engineers** of Canada

A number of Central Stations have already requested our services for their *annual Fall preparation* for the heavy winter load, but there are a number of you from whom we have not heard.

We wish to thank those of you who have favored us with orders and also to assure the hesitant ones that their work will receive the same *careful and prompt attention* which has made our old customers our good business friends.

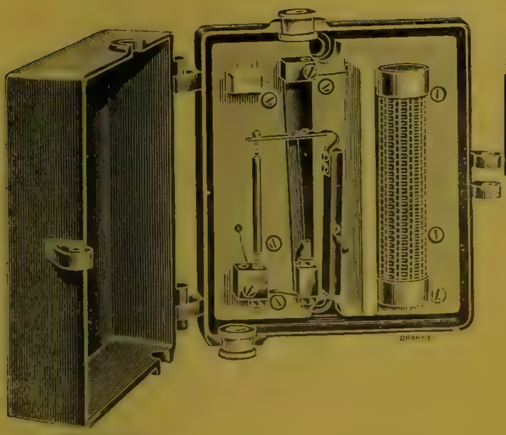
When sending in your work, we would be pleased to have your suggestions for changes your daily observation of the machine has shown necessary.

REMEMBER

The Electrical Maintenance & Repairs Co.

162 Adelaide Street West, TORONTO
Phone Main 3419

The Specialists in the Cure of Electrical Diseases.



PROTECTION

For Electric Lighting Companies

The N.C.S. THERMAL LIMITER

(PATENT)

protects the company in all cases where light is paid for on the flat rate system. It warns the consumer when he is exceeding his contract and also makes it impossible for him to continue to use light until he has reduced the demand to the agreed limit.

The ***N.C.S.*** Thermal Limiter consists of two bars with a wire attached to a spring contact; the bars are of iron, as is also the wire; this arrangement ensuring absolute compensation for any changes of temperature. It is free from self induction, and equally suitable for Direct Current or Alternating Current circuits.

The whole apparatus is mounted on a china base and enclosed in a cast-iron case, and is so arranged that it can be sealed. It can also be used in conjunction with a fuse box.

THE WAY IT WORKS

is as follows:—When the candle power is exceeded by switching on an additional lamp, the extra current will cause the wire to expand and open the contact at the extremity of the spring. This puts a resistance into the circuit, thus dimming the lamps, and at the same time the wire cools, and closes the contact again; and thus the cycle of operations is repeated. This produces continual flickering of the lights, which will cease as soon as the additional lamp is switched off. A condenser is arranged across the gap to prevent any sparking which might otherwise ensue.

CHAPMAN & WALKER, Limited

69 Victoria Street, - - - - TORONTO, ONT.

ENGINEERS' SUPPLIES AND STEAM SPECIALTIES

TRADE MARK
J.M.T.
REGISTERED
A GUARANTEE OF QUALITY

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SPECIAL FEATURE—ARTICLES ON POWER TRANSMISSION

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas,
Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Ltd.

MONTREAL: Eastern Townships Bank Bldg. TORONTO: 10 Front St. E. WINNIPEG: 511 Union Bank Bldg. LONDON, ENG.: 88 Fleet St. E.C

Vol. III. Publication Office, Toronto—April, 1910 No. 4

THE REASON WHY

PENBERTHY
Brass Goods
have an enviable
reputation is due
to the fact that

They Have Always Made Good

The PEERLESS Sight Feed Lubricator has special features not found in other cups.

It is specially recommended for stationary and the better class of engines.

It is—
Exclusive in Design
Scientific in Construction
Reliable in Action

" Put a Peerless on your engine and your lubricator troubles will be over."

The GENUINE PENBERTHY Injector has given satisfaction to users for a quarter of a century, because it is made right.

Every detail in its construction is carefully inspected and in every respect it is mechanically perfect. It might be said of the Penberthy Injector that "it is built like a watch."

Don't make the mistake of buying something else because the first cost is less. Get the Genuine Penberthy and you will get with it "everlasting satisfaction."

MANUFACTURED BY
Penberthy Injector Co., Limited, - Windsor, Ont.

Condensing Apparatus

The Condenser until recently has received far less consideration than the steam engine, but the advent of the steam turbine and the demand for higher economy have compelled the recognition of the condensing apparatus as one of the principal parts of a steam plant.

Condenser at Canadian Car and Foundry Co., Blue Bonnets Plant

Advantages of Condensers

1. Power is increased with the same fuel consumption.
2. Fuel is saved with same output of power.
3. Boiler feed water is saved in proportion to saving of fuel.
4. Boiler feed water is freed from lime and other scaling qualities.
5. Noise of escaping exhaust steam is stopped.
6. Boiler pressure may be lowered 10 to 20 lbs. without reducing power economy.
7. Number of boilers necessary for a given power may be reduced.

Descriptive Bulletins will be sent on application to our nearest sales office.

The John McDougall
Caledonian Iron Works Co., Limited

WORKS——MONTREAL

Sales Offices:— Montreal Toronto Cobalt Winnipeg
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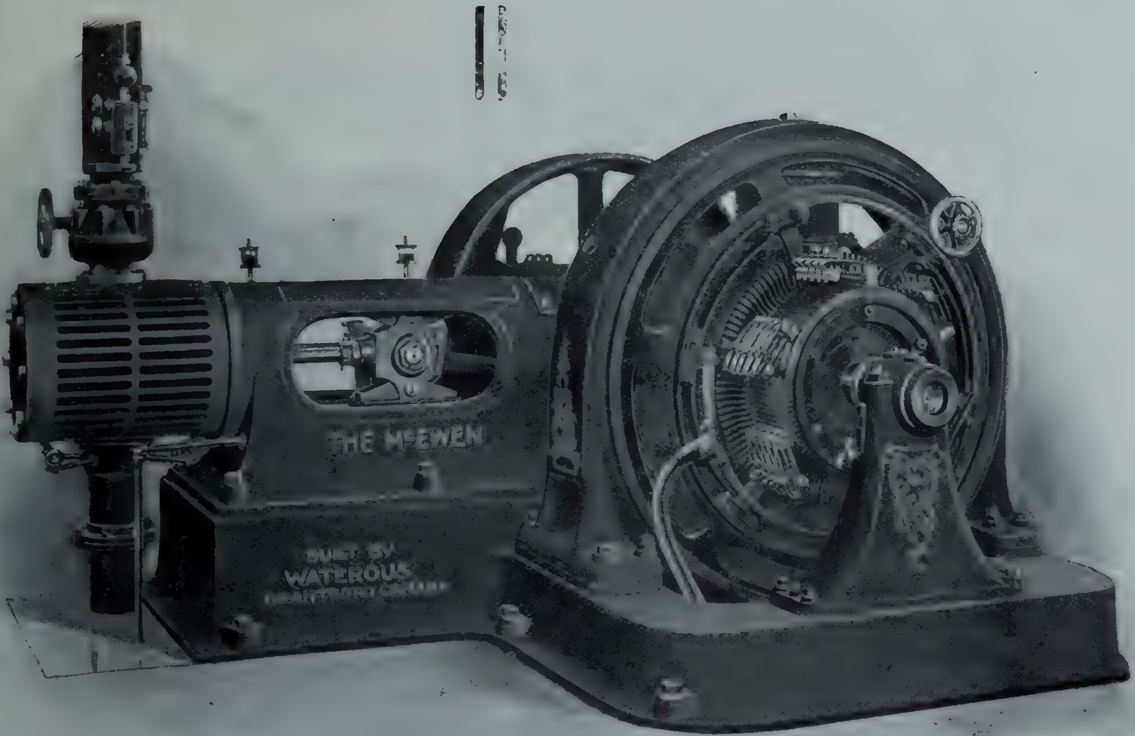
"The McEWEN"



This illustration represents our Horizontal Automatic High-speed Engine, which we build in simple and compound units from 10 to 700 horse-power. Heavy, rigid bed designed for accessibility and for endurance. Cross-head guides, main bearings, and face for cylinder attachment, are machined in one operation to ensure perfect alignment. Cross-head guides are cast as part of the frame. They cannot be misadjusted. Valve of the piston type, perfectly balanced in every position, and is practically frictionless. Valve is double-ported. Balancing pressure plate is slotted to correspond with valve seat. Produces additional passage to cylinder by providing double admission and exhaust edges. Relief valves are made absolutely unnecessary. Guaranteed control by our famous Begthrup Inertia Governor. The McEwen Engine is adapted to all kinds of work. Its particular field is driving electric generators, for lighting, power, street railway and mine haulage. Every engine built on the duplicate part system, and thoroughly tested before leaving our Works.

Send us your conditions and ask for bulletin.

The Waterous Engine Works Co., Ltd.

Brantford, - - Canada

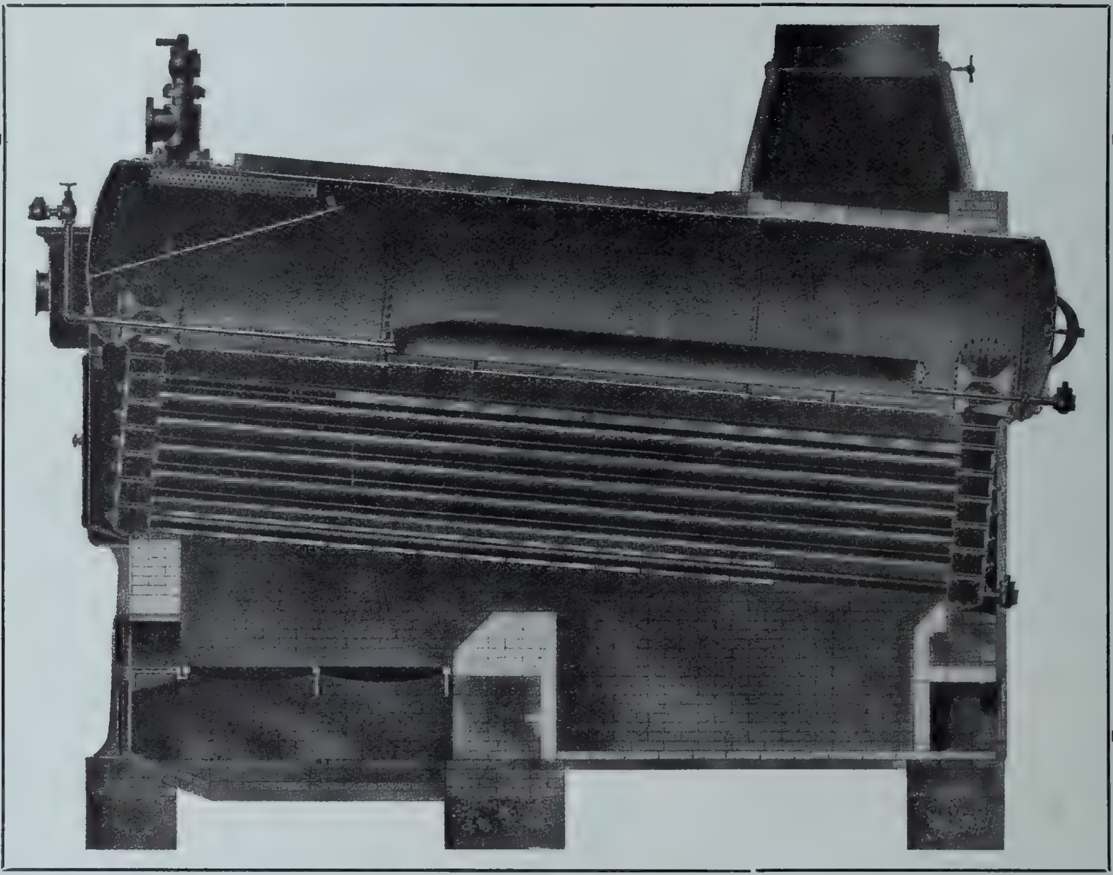
FOUR CARDINAL CONDITIONS

in a Modern Boiler are demanded by the best practice—

Economy of Fuel. ***Safety and Durability.***
Economy of Space. ***Accessibility for Cleaning.***

and after 25 years of experiment and improvement we claim that the

HEINE SAFETY BOILER



in these respects, more nearly approaches the ideal boiler than any other on the market.

The *"Heine"* is not a cheap boiler, but if cheapness is measured by giving due weight to the above conditions, in the long run the *"Heine"* will be found far the cheapest to instal.

Each boiler is completely set up and tested prior to shipment.

Our literature will interest you. Send for it.

Agents for Province of Quebec—Watson Jack & Co., 709 Power Bldg., Montreal

POLSON IRON WORKS, LIMITED

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Horizontal Tubular Boilers

Our Horizontal Tubular Boilers are carefully designed, and the materials used in their construction the best obtainable of their respective kinds.

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Write Nearest Sales Office.

We Contract for Complete Steam Power Plants, Engines included.

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GENERAL OFFICES: Sherbrooke, Quebec WORKS: Sherbrooke, Quebec; St. Catharines, Ontario

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"INGLIS" Corliss Engines

Represent the highest mechanical efficiency with the greatest economy.

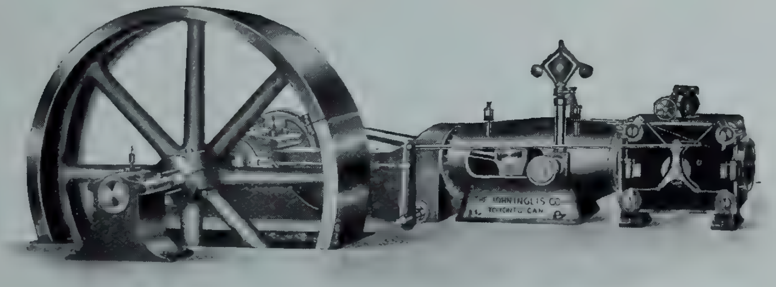
The many improvements we have perfected make the "Inglis" Corliss prominent as

The Modern Corliss

Built single cylinder, tandem or cross compound and triple expansion for light or heavy duty.

Our thirty-five year reputation is back of every Inglis Engine.

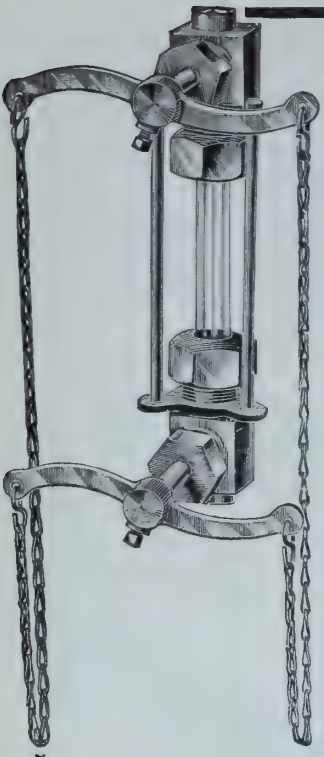
Specifications and prices gladly furnished upon request.



The John Inglis Company, Limited

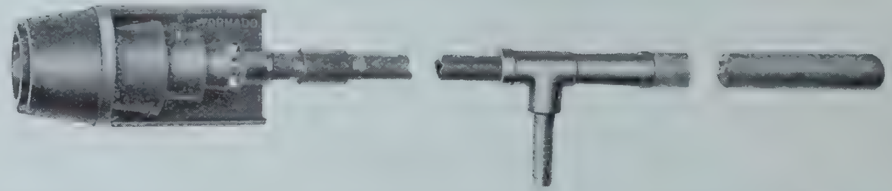
ENGINEERS AND BOILER-MAKERS

14 Strachan Avenue, Toronto, Canada

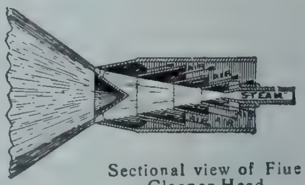


If You Desire To Save Troubles In Your Boiler Room—Use

The ***"P.B.H."*** QUICK-CLOSING WATER GAUGE is an accident insurance against scalds and burns. If the glass breaks, a pull of the chain shuts off both the steam and water. Its structure is perfect; extra heavy body, best steam metal with extra large nuts for extra heavy washers. Less than a quarter turn of stem fully closes or opens valves. ***Sent on trial.***

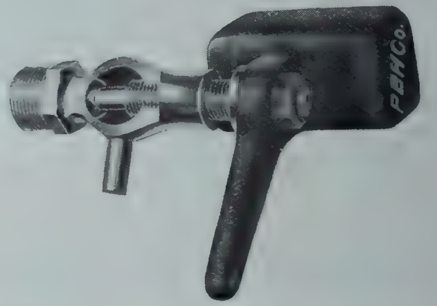


The ***"TORNADO"*** STEAM BOILER TUBE CLEANER not only does the work better than any other cleaner but does it in shorter time and more economically. Because the air injected by a small volume of steam carries no moisture to wet the soot, but blows it out through the longest tubes. **Sent on trial.**



Sectional view of Flue Cleaner Head

The ***"P. B. H."*** QUICK OPENING, SELF-CLOSING GAUGE COCK; it is simple, efficient, economical and quickly repaired. It combines all the mechanical perfections which make it a GAUGE COCK. GUARANTEED LEAKLESS for years. ***Sent on trial.***



We also make the Mather Boiler Blow-off Pipe Protector. Have you seen it? Do you know what it is?

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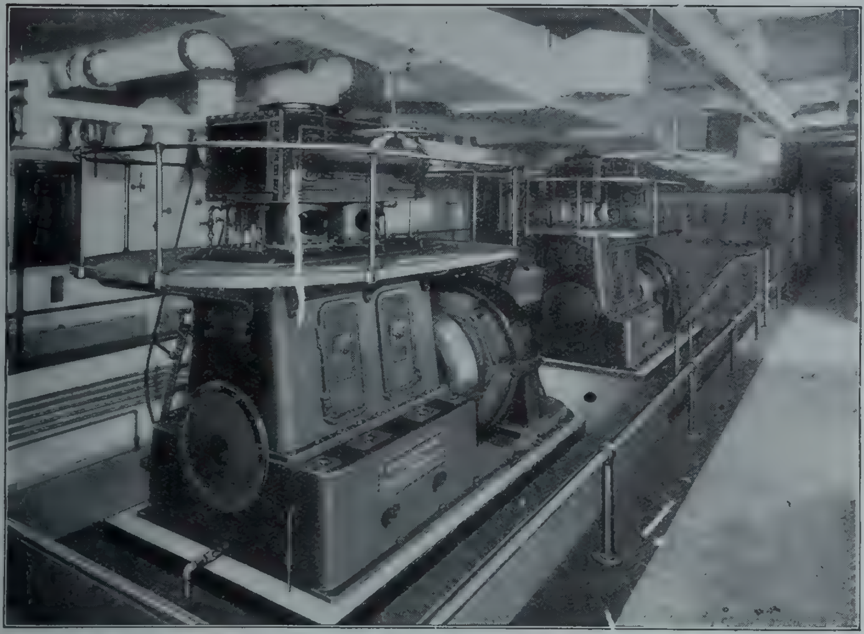

Has Cost Nothing for Repairs

A customer says:—

"We have used one of your vertical high speed engines, English type, forced lubrication, since 1907. The engine runs at 425 revolutions per minute almost constantly night and day. It has given us every satisfaction and so far has cost us nothing for repairs."

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Traders Bank Building, TORONTO; Wm. McKay, Manager
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Belliss Engines

IN COMBINATION WITH

Belliss Exhaust Turbines

bring down the steam consumption to a point unobtainable five years ago.

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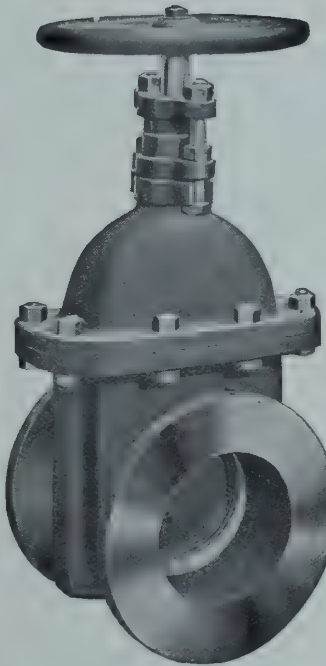
Consulting and Contracting Engineers
Board of Trade Building, MONTREAL



KERR GATE VALVES

are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

Write for our Catalog of High Grade Brass and Iron Valves.

The Kerr Engine Co., Limited
Valve Manufacturers
Walkerville, - Ontario

LUNKENHEIMER "RENEWO" VALVES

ARE POSITIVELY THE MOST DURABLE AND PRACTICAL MADE

THE SEATING SURFACES CAN BE REGROUND and ALL PARTS SUBJECTED TO WEAR CAN BE RENEWED; including the DISC and SEAT. The SEAT is SELF-CLEANSING and is made of a hard, close-grained nickel. The bronze used contains a high percentage of copper and tin. The improved construction of the Disc PRESERVES THE SEATING FACES and PREVENTS WATER HAMMER.

LUNKENHEIMER "RENEWO" GLOBE, ANGLE and CROSS VALVES are guaranteed for 200 pounds working pressure, and are made in sizes ranging from ¼ to 3 inches, inclusive.

"Most supply houses sell them—yours CAN—if they DONT or WONT, tell US.'

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THE LUNKENHEIMER COMPANY

Largest Manufacturers of high-grade Engineering Specialties in the world

General Offices and Works
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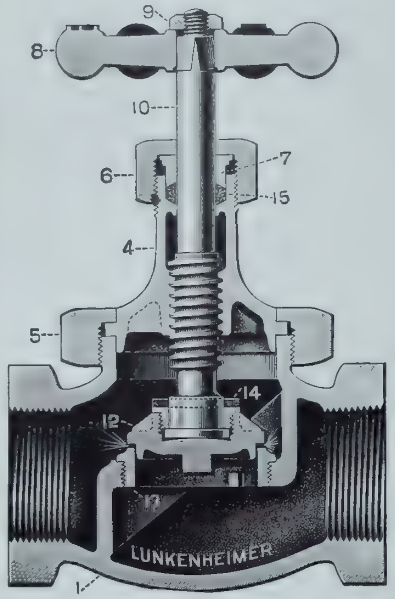

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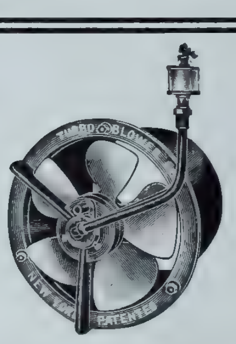


PROFESSOR LUCKE STRIKES THE NAIL ON THE HEAD

Charles Edward Lucke, Professor of Mechanical Engineering of Columbia University, N.Y., said the other day:

> "Excessive air has just as much harmful effect on the efficiency of a boiler as a stream of water, played on a fire, would have. Upon the control of this excess air the efficiency of a boiler depends more than on any other single thing,"

which shows how really important a device is the

Turbo-Blower

The Turbo-Blower produces the *proper* draft necessary to burn all classes of fuel, in such a manner as to effect complete combustion.

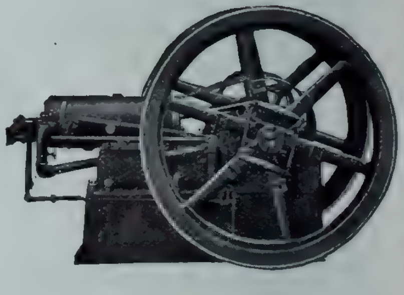
It increases the boiler capacity from 25 to 35 per cent., and gives you "The Same Power for Less Money, or, More Power for the Same Money."

Write for the Turbo Catalog.

The Turbo-Blower Co., 30 Church St. NEW YORK, N.Y.

or W. H. ADAMS, 102 Nazareth St., Montreal
STANDARD ENGINEERING CO., 47 Wellington Street East, Toronto

Let An I.H.C. Engine Drive The Wheels For You



You can absolutely depend on an I.H.C. Engine to do the work right—at the lowest price. Thousands of power users have found I.H.C engines to be most dependable, simple, economical, powerful and durable. You will too. There is

One To Meet Your Needs

Whichever I.H C. Engine you choose, will net you the biggest returns. 1 to 25 Horse-power, vertical or horizontal, portable or stationary, water-cooled or air-cooled—choose the one that suits you. Traction Engines in sizes 12, 15 and 20 Horse-power. See the Local International Agent to know all the I. H. C. advantages—or write direct to us for catalogues and any information you want.

International Harvester Company of America
(Incorporated)
50 Harvester Bldg. CHICAGO, U.S.A.

Dont let your money go up in smoke

THE COST OF SMOKE

¶ What proportion of the coal fed to the locomotive is actually used in power?

¶ About 6 per cent.; the rest is wasted.

¶ What part of the fuel value of their coal do the furnaces of the great manufacturing plants actually apply to driving the machinery?

¶ Not over 10 per cent.; often less.

¶ The rain of cinders from the locomotive, the pillar of black smoke from the factory chimney, account conspicuously for the waste. The great loss, however, is in the form o unconsumed gases which escape into the air without having been of any steam-producing value.

¶ These gases escape because, as is well known, perfect combustion has never been discovered as yet. The gases escape from the coal so rapidly that, before they are mixed with the necessary air (providing oxygen) they have passed away from the point of combustion—which is at the surface of the burning coal.

¶ The rescue of a small proportion of the 90 per cent. of fuel value thus wasted would mean a large proportion of the 10 per cent. now ordinarily used.

¶ This should be easily done.

¶ It has been done, and is being done. It can be done in every plant—in yours with the rest. Chemistry has produced in the *FISHER FUEL ECONOMIZER* a substance which when applied to the coal forms an exceedingly thin film over it and causes the valuable heat-producing gases to be held in the coal itself, and the coal and the gases are consumed together, thus preventing the waste of valuable gases which take place when the coal is consumed without the treatment.

¶ Indisputable evidence is available that by the use of

FISHER FUEL ECONOMIZER

Black smoke and flying cinders are eliminated, which has been proved on locomotives pulling the fastest passenger as well as the heaviest freight trains. Many evaporation tests in the power plants of the largest corporations in Canada show increase of efficiency ranging from 10 to 25 per cent.

¶ We save money for the factory owner and railway.

¶ We save the fireman much hard and dirty work.

¶ We save the black smoke which pollutes the air.

¶ We reduce your ashes and clinkers half.

¶ We increase and maintain steam to a degree which is impossible without the economizer.

¶ We keep your boiler tubes and grate bars clean, reducing expense of upkeep.

Let Us Prove It to You. Write To-day for Information

Phone Main 2390

Fisher Fuel Economizer Limited

Head Office, 74 Bay St., Toronto, Ont.

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212 St. James Street	**35 Mackay Street**	**310 McGreevy Block**
Phone Main 3497	*Phone 1879*	*Phone Main 2750*

Quality—Efficiency—Reliability

These, together with reasonable cost, have established the reputation of

Mason Reducing Valves, Pump Pressure and Speed Regulators, Damper Regulators, Balanced Valves.

Reilly Multicoil Feed Water Heaters, Condensers and Evaporators—the most compact and efficient.

It is not what you pay for an article, but what the article pays you in return for its cost, that determines its real value. . . . . .

(Genuine)
Ashton Pop Valves, Relief Valves, Pressure & Vacuum Gauges Alarm Gauges.

Berry Safety Automatic Boiler Feed Control—the simplest and best.

Bundy Steam Traps and Separators

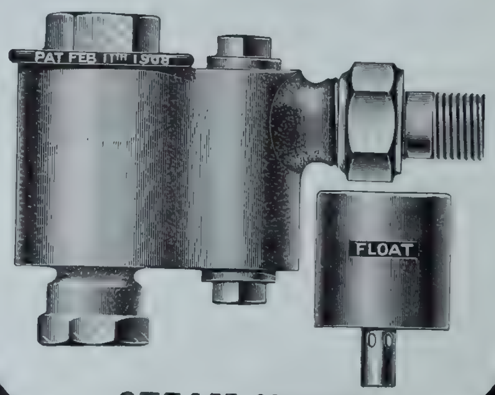
We design complete systems for returning condensation direct to the boilers, and we can effect economies in most steam plants.

Catalogues and full infomation are at your disposal.

PEILER & MACKENZIE, - 52 St. James Street
MONTREAL

Factory Owners

THE AUTOMATIC VACUUM



STEAM VALVE

Save Money!

Utilize your exhaust steam now going to waste

and heat your building perfectly and economically

That's what our **ECONOMIC VACUUM STEAM HEATING SYSTEM** will do for you

1. It makes for ECONOMY by eliminating BACK PRESSURE on engine supplying exhaust.
2. It entirely does away with water-hammering and pounding in pipes.
3. It prevents water-logging in Radiators by exhausting all water.
4. It does away with air-binding in Radiators by exhausting the air.
5. It gives higher temperatures to dryers, dry kilns, coil stacks and paper cylinders by removing water of condensation.

Hundreds of firms have installed this system with most satisfactory results.
Write us for particulars and let us give you an estimate on the cost of heating your building.

Canadian Steam Boiler Equipment Company, 186 Queen Street East, Toronto

THE "CYCLONE" GRATE

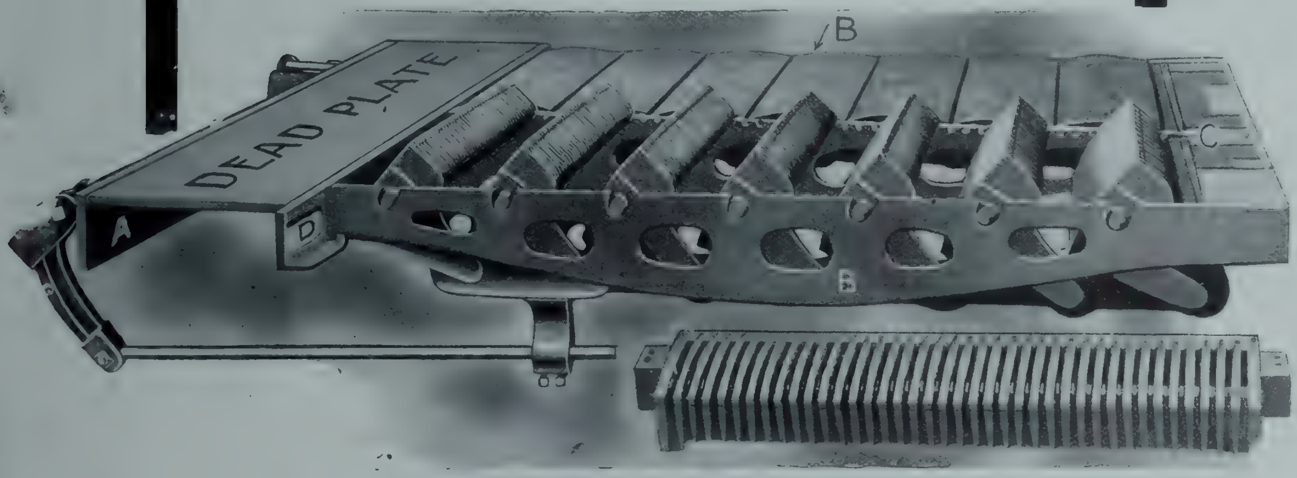
Two Features Which Make It Superior to all Others

FIRST. An immense improvement in the shaking apparatus, whereby *all* the ashes are passed through the grate. This result is obtained by a V-shaped cut in the trunnion, which works in an irregularly-shaped socket on the side bar. By this device, the shaking is rendered very much more vigorous, and no ashes remain on the centre of the grate—the place where, in other makes, they are usually found to cling.

SECOND. In the centre of the grate the width between the bars has been increased to half an inch, with bar of ⅜-inch iron. This increased air space, and consequent increase of draught, has proved most efficient in the production of more steam for the amount of fuel consumed.

Leading Engineers throughout the Dominion are high in their praises of the efficacy and wearing qualities of the "Cyclone."

Let us have your enquiries. Circulars and further information yours for the asking.



Canadian Steam Boiler Equipment Company, Limited

(Sole Manufacturers for Canada)

186 Queen Street East, - TORONTO

AGENTS:

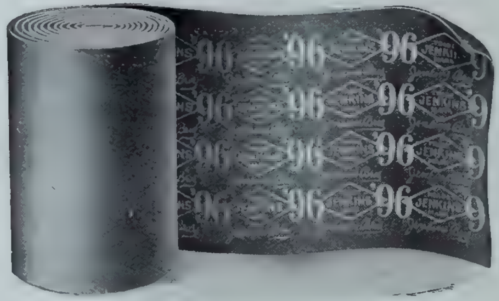
ST. JOHN, N.B.—F. W. Blizzard,
Canada Permanent Chambers.

MONTREAL—Lowden & Mead,
18 Bleury Street

HAMILTON—Robt. Fitzsimmons,
8 Grove Street

The End of all Packing Troubles is Jenkins '96

A Money-Back Proposition.



It Costs You Nothing To Try It.

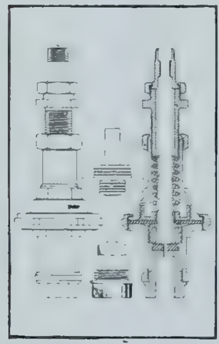
Haven't you a steam joint that has caused you a lot of trouble lately? If so, send us particulars and we will send you a sample. You apply the sample and end the trouble.

This packing is absolutely guaranteed. It pays for itself in efficiency and length of service.

SEND THAT TRIAL ORDER TO-DAY and when sending for the packing ask for Valve Catalogue.

JENKINS BROS., Limited,

102 St. Remi St., : : : : MONTREAL



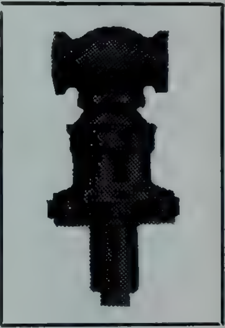
REDUCTION VALVE
for water, steam or air
Patent applied for

Engineers! Attention!

Keep cool! Don't worry your employer! Make your fireman look pleasant! How to do this! Use

W. H. Bice's Steam Appliances

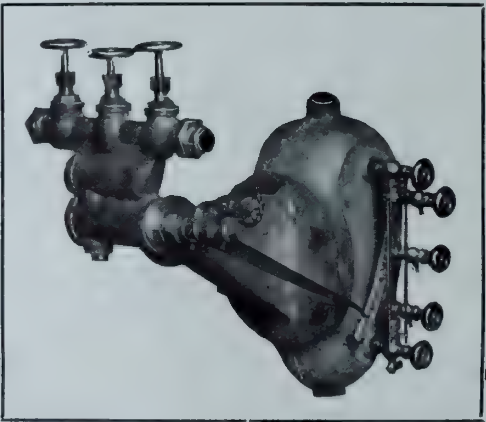
which keep water at given level, give dry steam, save fuel and make employer and fireman glad. Write for testimonials and price list.



PUMP GOVERNOR
Patent applied for

Manufactured by

Automatic
Feed
and
Regulator
Company

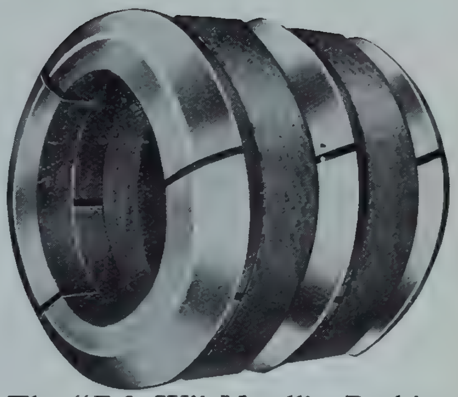


FEED WATER REGULATOR. Patented Feb. 1st, '10.

100 Masonic
Temple

London,
Ontario

WE GUARANTEE
THIS PACKING



The "F & W" Metallic Packing
"The kind you put in and forget"

Will Cost You Less

Both in first cost and Maintenance than any other metallic packing.

So that the packing may speak for itself

Let us Send you a Set for 30 Days' Trial

If not satisfactory you will not have to pay one cent and can return it at our expense. Give diam. of rod and stuffing box and depth of latter. Also service.

Send for new Catalogue. Just off the press.

The Power Economy Company

9 St. Nicholas St. Power and Fuel Saving Specialists Montreal

Agents for the Liberty Modern Power Plant Accessories
Claflin's Steam Tube Cleaners

We can supply anything you could need in your Power Plant.

TAURIL

The one High Pressure Jointing that is always Satisfactory

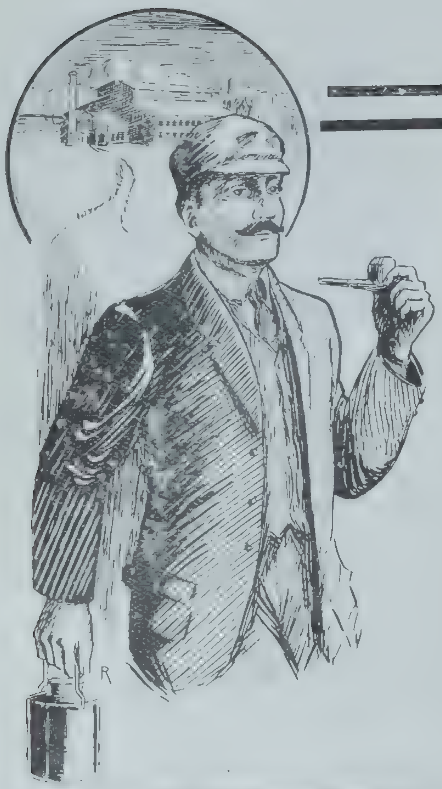
We recommend Tauril and guarantee it to be the best high pressure jointing made for such work as Steam (dry or super-heated), Motor Cars, Refrigeration Plants (Ammonia and Cold Air Systems), Compressors, and long lengths of pipe to auxiliary machinery (subject to condensation, water hammering and unequal expansion).

Tauril will stand a varying temperature up to 572° Fah.; has a tensile strength of three tons per square inch and stands a compressive strain of fourteen tons and still retains its elasticity.

Write for Descriptive Booklet.

The Garlock Packing Co., Hamilton, Ontario

Sole Agents for Canada.



No Night Work

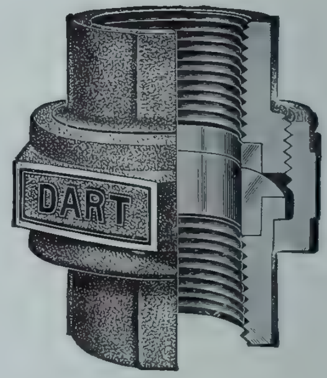
fixing leaky joints for the engineer who operates
a plant where steam-pipe joints are made with

DART UNIONS

Dart Union Joints

Cannot Leak

No packing whatever is required with Dart Unions. Both sections are seated with smoothly-ground, non-corroding Bronze. These sections form a **Ball-Joint** that can be made with surprising speed; and that, when made, will remain steam, air, gas, oil and water tight until you loosen it deliberately.



If your dealer does not handle Dart Unions write direct to us.

Dart Union Co., Limited

93-97 Niagara Street
TORONTO : : ONTARIO

Real Economy

is being practised when you make use of your exhaust steam to heat your feed water. And the

NATIONAL

Feed Water Heater

will do this for you more effectively than any other similar device on the market.

From one to fourteen coils of *seamless drawn* brass or copper tubing are encased in a cast iron or steel shell to which *exhaust steam* is admitted, heating the water passing through the tubing.

There are no inside joints to leak, no leaky straight tubes, no back pressure, and no contact of water with shell or iron.

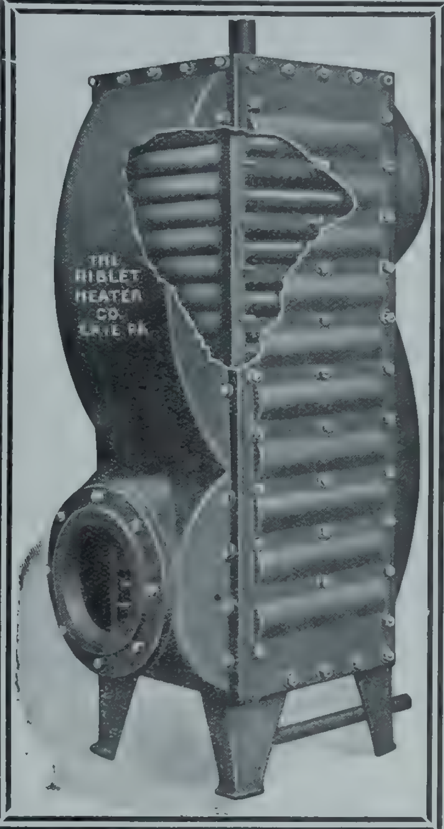
Send for our booklet on Feed Water Heating. It's free to you for the asking.

The National Pipe Bending Co.

91 Lloyd Street
NEW HAVEN, - CONN.
U.S.A.

The only Heater

that will heat water to the boiling point from a *Gas Engine* as well as from a Steam Engine is the



Transverse Current Water Heater

Being made of iron it will not easily corrode, and is not affected by electrolysis or acids. There are no tubes to scale, no joints to leak, and no floats to require attention. Water passages are easily accessible for cleaning, and it can't possibly get out of order.

You'll find this heater will more than pay for itself in fuel-saving in a few weeks.

Send for descriptive booklet.

The Riblet Heater Co'y

Box 18—ERIE, Pa.

General Agents in Canada

The Standard Engineering Co., Limited
47 Wellington St. W. - TORONTO

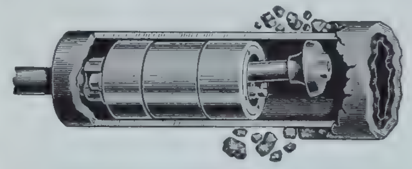
Boiler Scale An Enemy To The Coal Pile

You can't generate steam with scale-incrusted tubes without wasting 10 to 30 per cent. of your fuel. Nor without having leaky and burned out tubes and having trouble in getting up steam.

The Dean Boiler Tube Cleaner

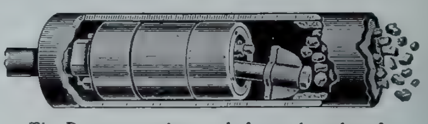
will save its cost several times over by solving the scale problem for you. It produces results that both the engineer and owner can see. It is guaranteed to pay for itself in six months' use.

Write TO-DAY for further particulars and our free trial offer·

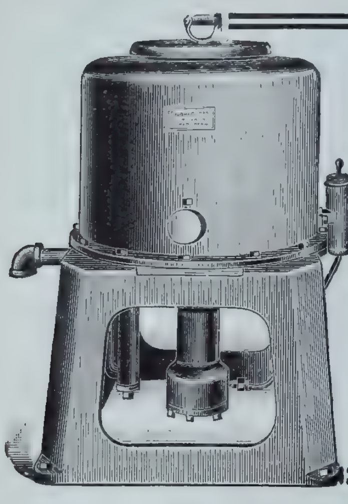


The Dean removing scale from the tube of a return tubular boiler.

THE WM. B. PIERCE CO.
330 Washington Street, Buffalo, N.Y.
Montreal Office : 230 Coristine Bldg., Montreal.



The Dean removing scale from the tube of a water tube boiler.



Save the Oil——Don't Waste Waste

We Manufacture—OIL and WASTE MACHINES, CHIP MACHINES, TURBINE CENTRIFUGAL OIL FILTERS, and CENTRIFUGAL EMULSION MACHINES

We have machines with—The E. B. Eddy Co., Ltd.; Grand Trunk Ry.; Can. Pac. Ry; Dominion Coal Co.; J. R. Booth; Toronto Water Works; T. Eaton Co.; Montreal Street Ry.; Nova Scotia Steel & Coal Co.; Toronto Railway; Algoma Steel Co.; Quaker Oat Co.; B. Greening Wire Co.; Imperial Oil Co.; Canadian Copper Co.; Sarnia Electric Light Co.: Robert Mitchell Co.; Montreal Rolling Mills; Canada Screw Co.; Crow's Nest Pass Coal Co.; Dominion Iron & Steel Co.; Temiskaming & Northern Ontario Railway Co.; Consolidated Mining & Smelting Co.; Montreal Cotton Co.; Frost & Wood Co., Ltd.; Dominion Textile Co., Ltd., and many others.

ASK FOR CATALOGUE

The Canadian Oil and Waste Saving Machine Co.
Limited
BROCKVILLE, ONTARIO

ENTHUSIASTIC

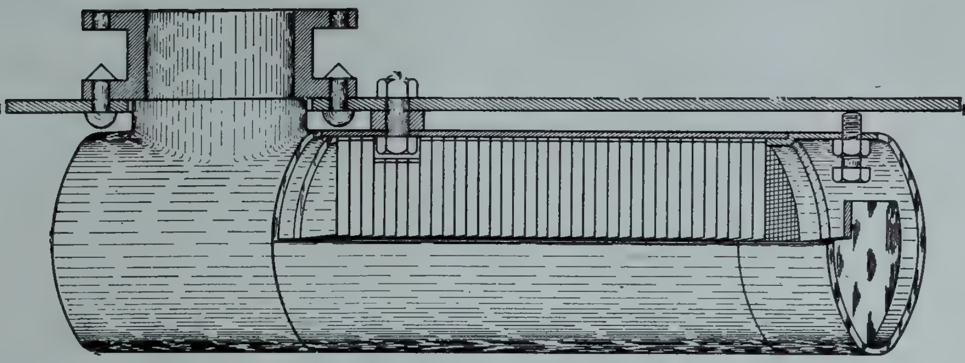
In praise of Diamond Smoke Consumer and

FLEMING GRATE BARS

Will outlast anything on the Market.

WRITE FOR PARTICULARS.

BUTTERWORTH FOUNDRY
LIMITED
BROAD STREET, OTTAWA
or F. W. Donaldson, 422 Euclid Avenue, Toronto



Wet Steam is Unnecessary, Expensive and Dangerous!

You can't hope to deliver your steam to the piston free of entrained water and foreign matter unless you instal an

IDEAL INTERNAL STEAM SEPARATOR

The "Ideal" absolutely safeguards your engine against damage through water-shock or the going out of cylinder heads. It also makes for economy by saving oil, packing and time, and by lessening the wear and tear of engines, pumps and compressors.

READ THESE TWO LETTERS

and remember that what we have done for others we can do for you.

WRITE FOR DESCRIPTIVE BOOKLET

Other lines each having distinctive features:

POTTER SEPARATORS; WHALEY AUTOMATIC SMOKE PREVENTERS: LEONHARDT GAUGE GLASS PROTECTORS

WRITE FOR DETAILS AND PRICES

We are Selling Agents for:

WATSON & McDANIEL CO., Philadelphia (Steam Traps, etc

HARRIS SMOKELESS FURNACE CO., Nashville, Tenn.

WRITE FOR CATALOGUES

Toronto, Canada, Jan. 31st, 1910.

Mr. Henry J. Allison,
820 Euclid Avenue.

Dear Sir :—

Since installing your Ideal Internal Steam Separator last December we find the following benefits :—

In place of using 2,600 lbs. of coal we are now using 1,850, heating throughout the building is fully one-third better.

Prior to installing the Separator the engine was occasionally flooded by returns, but now the trouble is completely overcome.

Wishing you every success in the introduction of your Separators, which, we feel sure, will be advantageous to any firm requiring similar defects remedied.

We are,

Yours truly,
PURE GOLD MFG. CO., Limited,
(sgd.) J. C. Jamieson,
Sec'y-Treas.

Ideal Steam Separator & Supply Company

820 Euclid Avenue
Toronto

Toronto, Oct. 28th, 1908.

Mr. H. J. Allison,
170 Strachan Ave., Toronto, Ont.

Dear Sir :—

Replying to your letter of the 1st, in reference to the Ideal Internal Separators installed in the boilers at the Central Prison, Toronto, I beg to say it is not customary to give testimonials from this Department, but in this case exception will be made. Two years ago an electric light plant was installed in the Prison and it was found necessary—owing to water being carried over to the engine—to cut off the steam supply from the Bonson boiler, this boiler's steam outlet is taken from the front head and water was carried over in large quantities. After a special internal Separator was made and installed, this boiler was again connected with the lighting plant and the results from same were satisfactory in every respect.

From information received from the operating engineer, and from my own observations, the trouble from water being carried over to engine is completely remedied. Yours very truly,

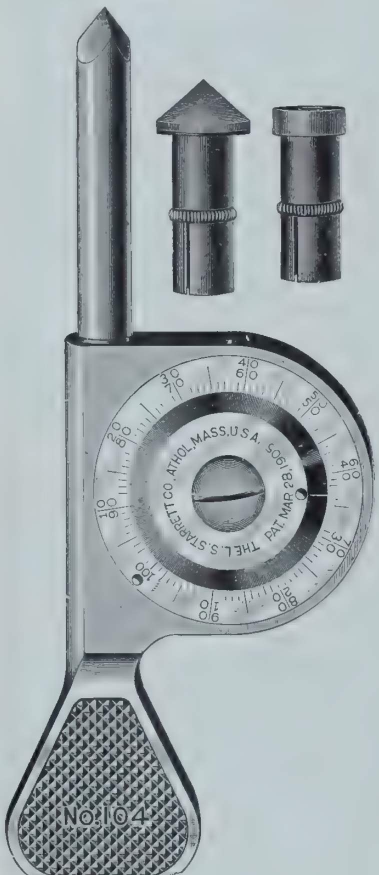
D. M. MEDCALF,
Inspector of Boilers, etc.

You May Have One of these Speed Indicators without Spending a Cent

if you are a subscriber to "THE POWER HOUSE." If you are not a subscriber, send in your own subscription together with two, three or six others, and the indicator you are entitled to will be mailed to you immediately.

To subscribers who send us two yearly paid-up subscriptions we will send the $1.00 *Indicator.*
To subscribers who send us three yearly paid-up subscriptions we will send the $1.50 *Indicator.*
To subscribers who send us six yearly paid-up subscriptions we will send the $3.00 *Indicator*

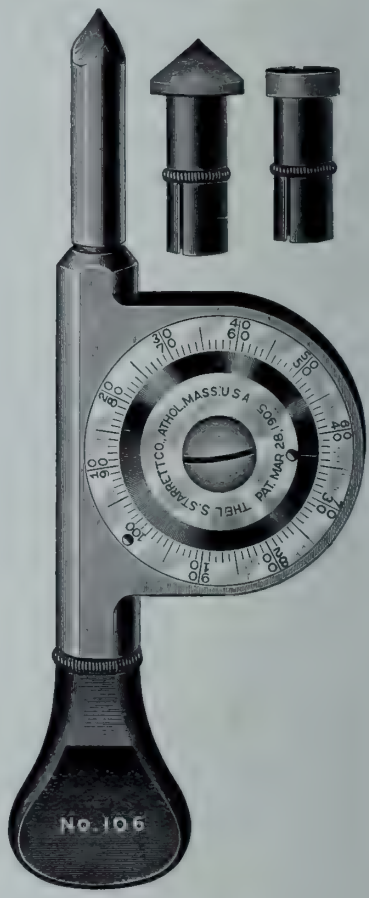
STARRETT HIGH SPEED INDICATOR, No. 104
Value $1.00
Given for two yearlv paid-up subscriptions.


THE L. S. STARRETT CO. ATHOL, MASS. U.S.A.
PAT. MAR 28, 1905
No. 104

THE L. S. STARRETT CO.
No. 107
ATHOL, MASS. U.S.A.

STARRETT REGISTERING SPEED INDICATOR No. 107
Value $3.00
Given for six yearly paid-up subscriptions.

STARRETT IMPROVED SPEED INDICATOR, No. 106
Value $1.50
Given for three yearly paid-up subscriptions.


THE L. S. STARRETT CO. ATHOL, MASS. U.S.A.
PAT. MAR 28, 1905
No. 106

"THE POWER HOUSE" is designed to give Canadian Engineers, Superintendents and Power Users all the latest and best information in the engineering field. A little work among your engineer friends and acquaintances will earn for you one of these handy indicators without any trouble. Try it and see how easy it will be.

PUBLISHED MONTHLY AT $1.00 PER YEAR
Start in TO-DAY to earn one of these Handy Tools.

THE POWER HOUSE - - 10 Front Street East, Toronto

Here's an Opportunity to Make Money

OPEN TO

Engineers in every part of Canada

25% Commission paid on Sales, and the sample can be carried in your pocket.

EVERY POWER PLANT (big or small) NEEDS IT.

IF YOU MEAN BUSINESS, WRITE

PECCO, 702 E. T. Bank Building, MONTREAL

The Nichols Chemical Company, Limited

HEAD OFFICE: 222 ST. JAMES ST., MONTREAL

ACIDS AND CHEMICALS

WORKS:
Capelton, Que.
Sulphide, Ont.
Barnet, B.C.

TRI-SODIUM PHOSPHATE

Purest Commercial, 100%, for prevention of scale in boilers.

WAREHOUSES:
Toronto, Ont.
Montreal, Que.

Notice! Engineers

Always Buy the Best. It Pays. You Can't Go Wrong When You Specify

It is decidedly superior to every other make.
Write For Circular.
Manufactured and Guaranteed By

The Canada Metal Co. Ltd., Toronto

Genuine
"Detroit"-Improved
Standard
Lubricator

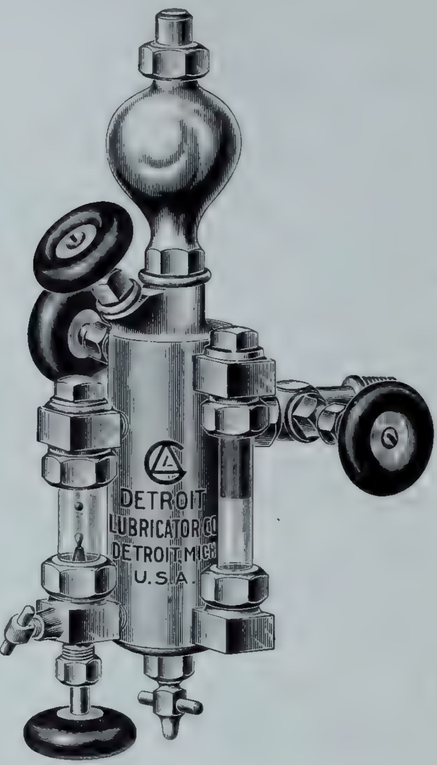
Send for
Catalog A58
Illustrating
339 Types-Sizes

Simple in theory.

All that skill and money can produce in construction.

Dependable in practice.

Every "Detroit" Lubricator is carefully inspected before shipping.



The first "Sight Feed" Lubricator was originated by the Detroit Lubricator Co. over thirty years ago.

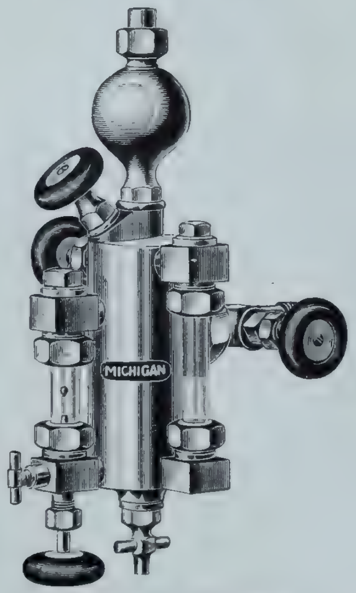
To-day we operate the largest plant devoted to the manufacture of Lubricating Devices in the World.

Be sure you get the Genuine "Detroit".

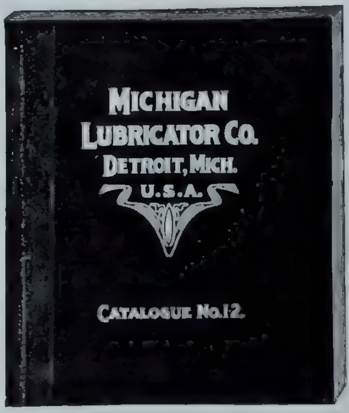
DETROIT LUBRICATOR COMPANY.
DETROIT, U.S.A.

MICHIGAN

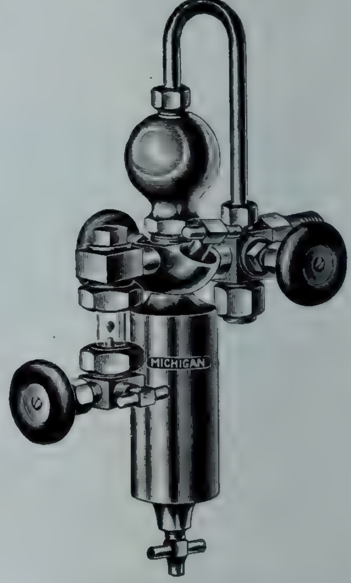
Illustrated catalog mailed to you free



Improved Double Connection,

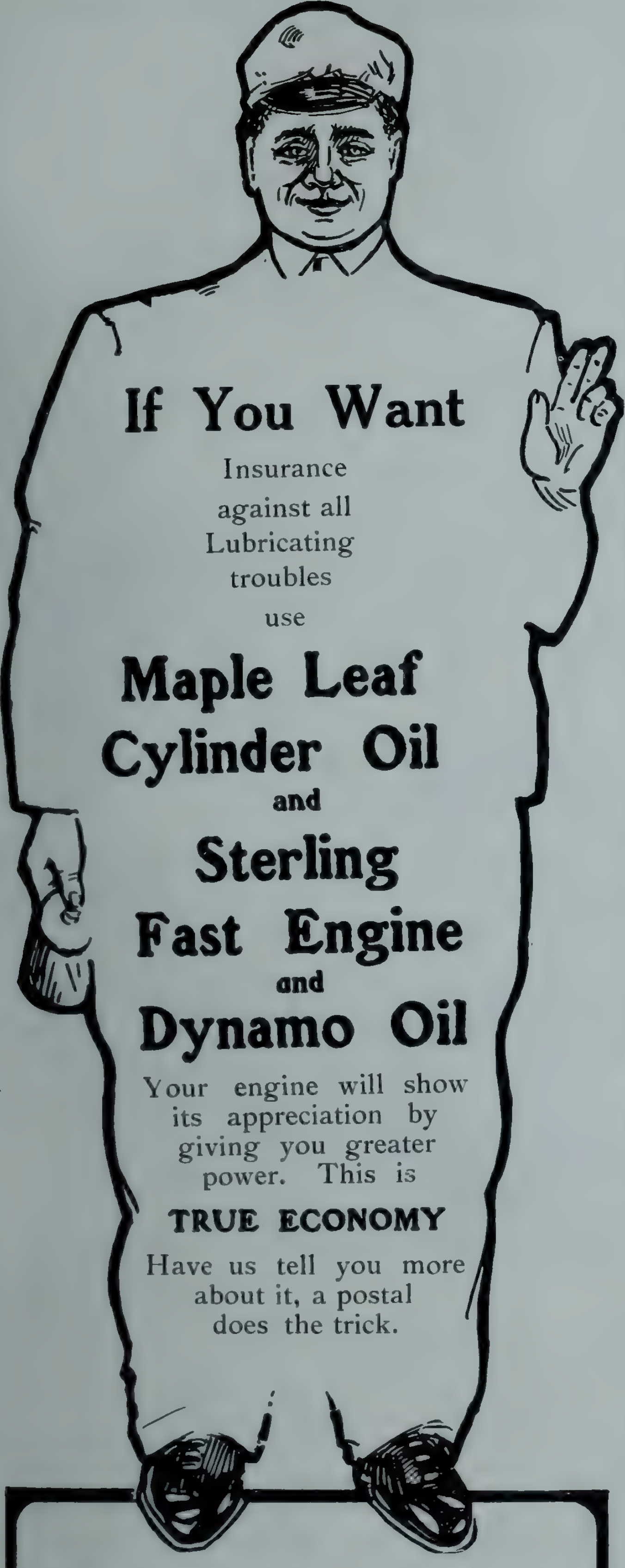

MICHIGAN
LUBRICATOR CO.
DETROIT, MICH.
U.S.A.
CATALOGUE No.12.

WRITE TO-DAY



Improved Single Connection.

MICHIGAN LUBRICATOR CO.
DETROIT, MICH.



If You Want

Insurance
against all
Lubricating
troubles
use

Maple Leaf
Cylinder Oil
and
Sterling
Fast Engine
and
Dynamo Oil

Your engine will show its appreciation by giving you greater power. This is

TRUE ECONOMY

Have us tell you more about it, a postal does the trick.

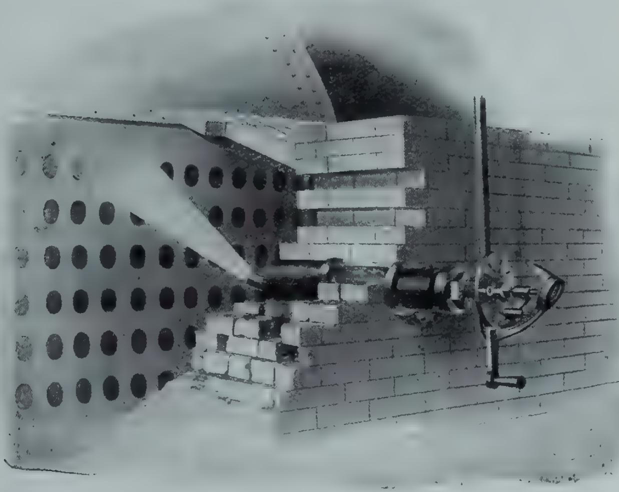
Canadian Oil Companies
LIMITED
TORONTO
Distributing Depots at all points in Canada

Don't Waste Your Fuel
SAVE IT

Keep Your Boiler Flues Clear Of Soot All of the Time

BY USING

"DIAMOND"
Steam Flue Blowers



in 5 minutes blows the soot entirely out of boiler.

The Least Coating of Soot in the Flues Means
Heat Wasted—Fuel Wasted—Money Wasted

Diamond Blowers Will Save It

SENT ON 30 DAYS' TRIAL

The "Diamond" Power Specialty Co.
Detroit Windsor, Ont. Berlin

Diamond Power Specialty Co., 222 Front St., Detroit

Gentlemen:—Without obligating me, you may send me a copy of your book "Economical Production of Steam," which I understand is a practical treatise on the operation and maintenance of "fire tube" type of boiler.

Name..

Address..

City..

Employed by..

Number and Capacity of Boilers in Operation..

The Flinn Trap

No Buckets, No Floats, No Expansion, No Joints to Pack, NO TROUBLE.

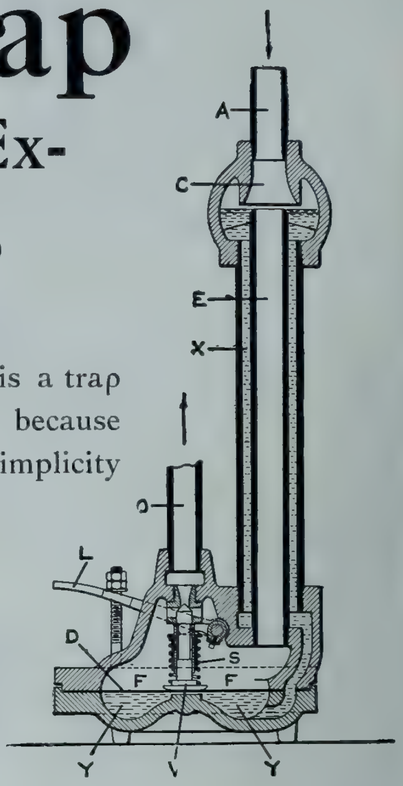
Works equally well on any pressure from one to 300 pounds and is a trap that can be recommended for almost any and every class of work, because it is the only steam trap on the market that embodies such simplicity with an equally wide range of possible adaptions.

Sold under our positive guarantee.

Richard J. Flinn, West Roxbury, Mass.

Canadian Agents

The Power Economy Co., Montreal



Try it, before you buy it!

I want you to let me prove that my TRAP is nearer the ideal sought after by Engineers than any other trap on the market. Will you let me send you a

DUFFY STEAM TRAP

on 30 *days' free trial?*. Its distinctive and controlling feature lies in the expansion and contraction of iron pipe in coil, as shown in cut. It possesses large draining capacity, and will drain system when steam is shut off, thus preventing danger from frost. Write me to-day.

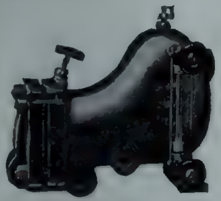
Francis Duffy - 136 Stuart Street - Kingston, Ont.

Notice to Stationary Engineers

Everyone operating a Stationary Steam Plant of 50 h.p. or over, in the Province of Ontario, must hold a Certificate from this Board. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary Engineers' Act

J. S. DUFF,
Minister of Agriculture.

W. C. McGHIE,
Chairman of Board,
Parliament Buildings, Toronto



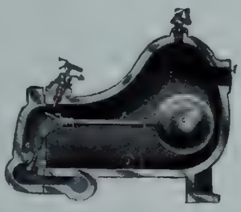
McDANIEL IMPROVED STEAM TRAP

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

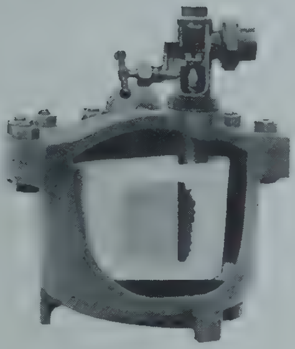
Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig St., MONTREAL, CAN.

IDEAL STEAM SEPARATOR & SUPPLY CO.
820 Euclid Ave., TORONTO, CAN.

The Least Expensive Non-Return Trap



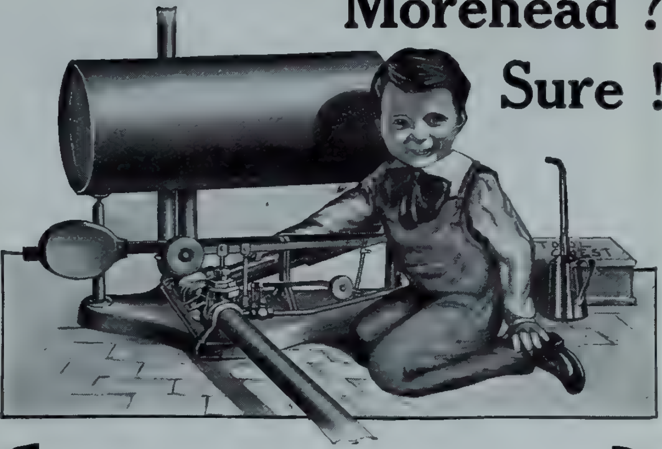
Get our price on this one—It is ridiculously low.

Class E.

Made by the **Inventors** of the **First Return Trap**

The Albany Steam Trap Co.

1319 N.
Pearl St
ALBANY, N.Y.



Morehead ? Sure !

You Can

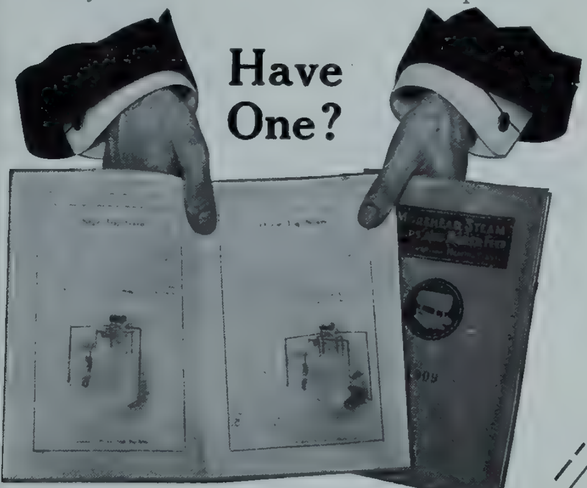
save fuel, time and money, and have a more harmonious working steam plant by draining your steam lines and returning the condensation direct to your boilers as pure, hot feed water.

If you will

use, in place of your present methods, an installation of a Morehead Return Steam Trap, you will find that your steam lines and boiler feeding system will give better satisfaction.

Now will you

write us your conditions and ask for a copy of "Trap Book" and our trial proposition? A trial will prove more to you than words can express—and you can make the trial at our expense.



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Department "J"
DETROIT, MICH.

Canadian Representatives:
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Please send me copy of your "Trap Book" and your trial offer proposition.

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The advertiser would like to know where you saw his advertisement—tell him.

Peerless Automatic Head Protector

Most Efficient and Reliable Apparatus of its kind on the Market.

Ammonia Proof—Fume Proof. Light in Weight and Compact

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For Cold Storage and Ice Making Plants

Patent Seamless CORK INSULATION—Efficiency With Economy

Send for our catalogue showing details of installations and containing many useful tables and other data concerning this industry.

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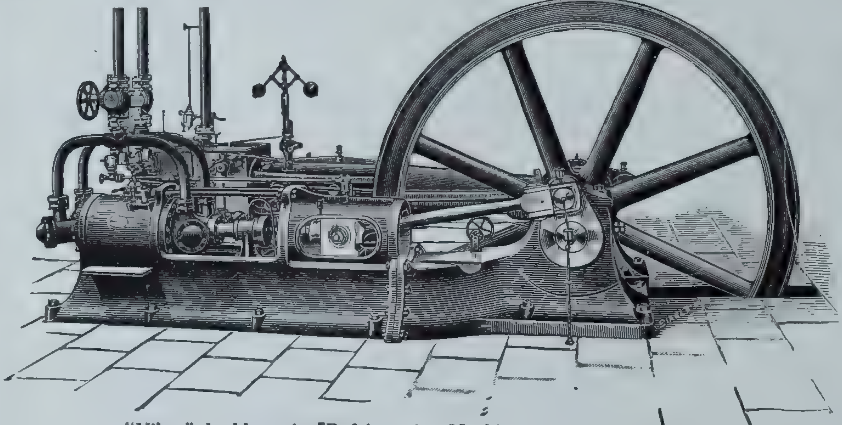
COMPLETE PLANTS DESIGNED AND INSTALLED



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Established 1867

The **VILTER MFG. CO.**
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CORLISS ENGINES
ICE AND REFRIGERATING MACHINERY

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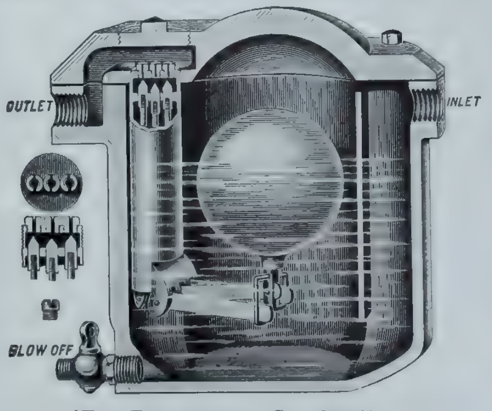

For Pressures up to 250 lbs.

WRIGHT "EMERGENCY"

High Pressure Continual Flow

STEAM TRAP

The "Emergency" trap drains the water from steam systems automatically and continually without steam waste and regardless of small flow or flood.

Write for pamphlet W.

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TORONTO Ottawa St., MONTREAL WINNIPEG

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Why be troubled with your belts slipping on pulleys when you can get the celebrated

"MAPLE LEAF" BRAND BELT DRESSING?

The best on the market for all kinds of belts.

Rubber, Leather or Stitched Cotton Duck.

This is not a sticky dressing; it contains no rosin or other materials so injurious to belts, but keeps belts pliable, causing them to cling to pulleys. Write for prices.

DOMINION BELTING CO., Limited
HAMILTON, CANADA

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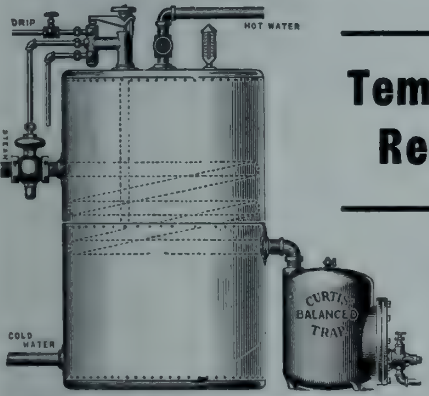

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For controlling the temperature of hot water in hotels, hospitals, etc.

Send for circular and 1910 catalogue.

JULIAN D'ESTE COMPANY
24 Canal St., Boston, Mass.

Cling-Surface has been used for NINE years. Read the results.

You can't ask for better results than the nine years of satisfactory service obtained through the use of Cling-Surface on the five belts in the Ludlow (Vt.), Electric Light & Power Plant.

The belt shown and the four others in the plant have been treated steadily with Cling-Surface throughout that time. The average cost for Cling-Surface per year on the water wheel belt has been about 31 cents, while on the generator belt the Cling-Surface has cost about 45 cents per year. During all these years the plant has had absolutely perfect belt service, that is, maximum transmission efficiency with minimum attention, cool bearings, economy of oil, no trouble and worry. The belts are better to-day than when Cling-Surface treatment was started and are easily good for twice the life that would have been possible without the Cling-Surface.

A belt once filled with Cling-Surface never has to be filled again. Only a little need be used afterwards—about once every month to keep the leather pliable and waterproofed.

We might ramble through dozens of good arguments in favor of Cling-Surface, but its performance in the above instance should be convincing to any man.

But the main point is this. Here is a man who acted nine years ago. He has had nine years of satisfactory belt service and is more enthusiastic about Cling-Surface than ever. YOU can get equally good results. Why not try Cling-Surface at once, especially when the cost of such a trial is insignificant? You are protected by our guarantee. Cling-Surface MUST prove satisfactory or you can have your money back. Write for our literature to-day and you can have your belt service improved in a week's time. Terms f.o.b., Toronto, duty paid.

Cling-Surface Co.
1051 Niagara Street Buffalo, N.Y.
New York Chicago Boston Memphis
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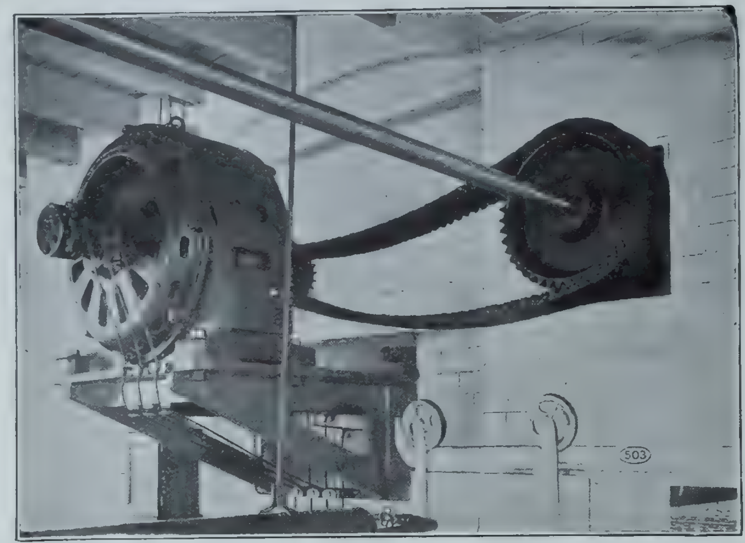
London—Thomas & Bishop, 119-125 Finsbury Pavement, E. C.

RENOLD PATENT SILENT **CHAINS**

(MANCHESTER, ENGLAND)



Transmit at a high speed any power and do it as quietly as a belt with the certainty of gears.

It is particularly suited to drives of short centres and, being Positive, effects a saving of power.

Insures against a breakdown and is absolutely no bother.

It is not affected by **Heat** or **Dampness.**

Write for particulars.

(From Motor to Lineshaft. Note there is no Tension)

Sole Canadian Agents

JONES & GLASSCO

St. Nicholas Building, MONTREAL, P. Q.

"Conweigh" Patent

BALL BEARING BELT CONVEYORS

Need No Lubrication. Bearings Absolutely Dustproof. Save as much as 35% Power.

SHAFTING
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SAFETY COLLARS
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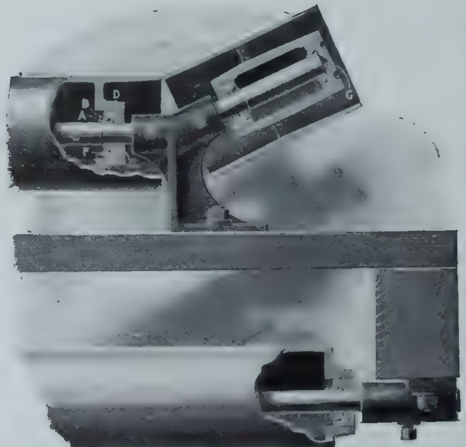

SPROCKET CHAIN
SPROCKET WHEELS
LEATHER BELTING
RUBBER BELTING
ELEVATOR BUCKETS

"Prompt Shipment Fair Prices"
OUR MOTTO

The Pulleys, being made of Shelby Seamless Steel Tubing, run true.

SEND FOR FURTHER EXPLANATIONS, PRICES, ETC.

The A. M. Ellicott Co., Montreal

SPECIALISTS IN CONVEYING, ELEVATING and POWER TRANSMISSION

Two
Pointers on
Transmission
by
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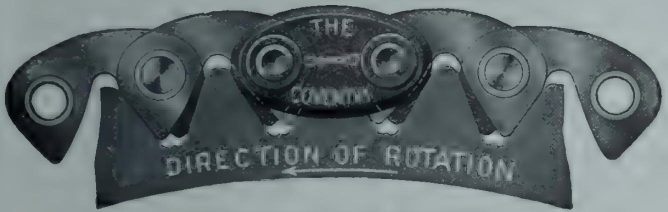
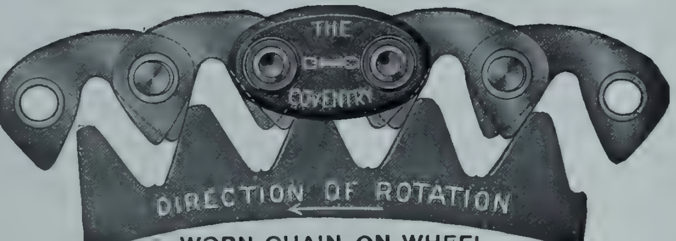
The
COVENTRY
Noiseless Chain
"Best of all"



NEW CHAIN ON WHEEL



WORN CHAIN ON WHEEL

Canadian Distributors
John Millen and Son, Limited
Montreal Toronto Winnipeg Vancouver
Address all Letters to 321 St. James St., Montreal

Ask us about our NEW one
THE CHAIN YOU CAN RUN CROSSED

Where lightness and flexibility are essential you can't get a better one—or as good.

D.K. McLaren's

Every H.P. of Energy—

that an engine develops is *transmitted* if the main drive is a D. K. McLaren belt.

D. K. McLaren's Genuine British Oak Tanned Leather Belting is absolutely the best belting made for these distinctive reasons:

1. We use only the finest selected hides for our belt leather.
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3. We use only the back cuts that are absolutely uniform in texture and entirely free from flaws.
4. Our method of splicing, lapping and cementing the leather is the result of many years' experience.
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For all general purposes you'll get the best by using our

EXTRA "C" and "D.K. BALATA"

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GENUINE BRITISH OAK TANNED

Leather Belting

The Philips

The less weight you carry on your line shafting

the less power it will take to turn it, the less money will be eaten up by oil bills.

The Philips Pressed Steel Pulley was designed with these points in view and, on account of the lightness of the pulley, special attention was paid to obtaining strength in construction and great durability.

Note then:—

THE RIM is formed from a single sheet of steel and consists of a double thickness of metal with deep flanges in center and on the edges. It is the best rim in the world.

THE SPIDER is heavily corrugated and joins the heavy cast iron hub on the outside—Giving great stability.

THE HUB is strongly and substantially made of cast iron, permitting perfect alignment.

The Philips pulleys are guaranteed equal under all conditions to double belt cast iron pulleys at half the weight.

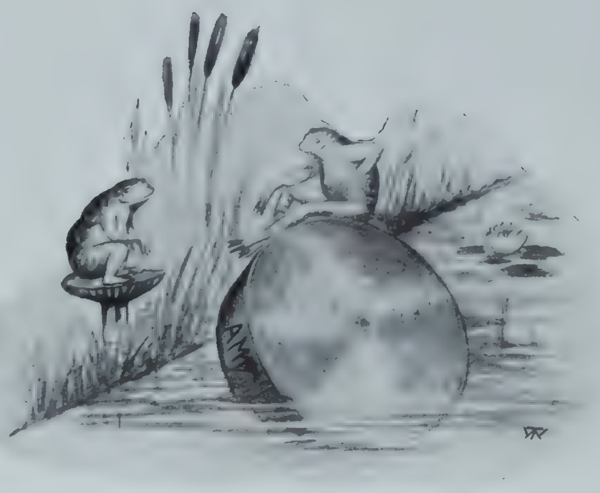
They Run Absolutely True!

Full stock carried by the Canadian Sole Agents

D. K. McLaren, Limited

(See branches with addresses on opposite page)

Pressed Steel Pulley



BELT TRANSMISSION IN WET PLACES

Requires a belt that will be at once impervious to moisture in any form and will not open at the joints when exposed to that moisture.

SUCH A BELT IS OUR

"AMPHIBIA"

(WATERPROOF)

Brand. You can take any joint of any piece of our "AMPHIBIA" WATER PROOF, soak it, boil it, or use any other similar test.

You can't injure it because it is a waterproof belt that is WATERPROOF.

We make this belting in the best equipped factory in Canada.

We tan all the hides ourselves. We use no chemicals in tanning—only the good old-fashioned, long-time process. The whole procedure from hide to pulley is under the direction of experts and many of our machines are the only ones of their kind in Canada.

BE BELT SENSIBLE—GET ONLY THE BEST, TANNED AND MANUFACTURED BY

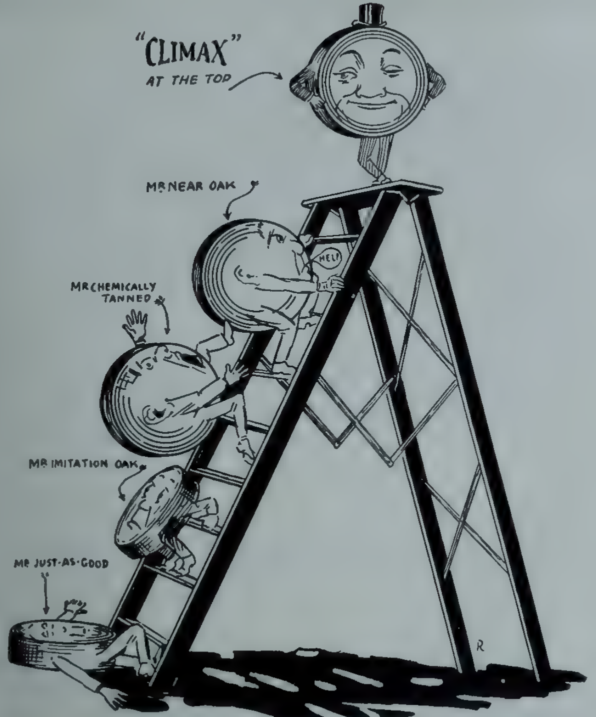
Sadler & Haworth

ESTABLISHED 1876

For 34 years the makers of the best belts

MONTREAL 511 William St.
TORONTO, 27 Melinda St.
ST. JOHN, N.B., 89 Prince William St.
WINNIPEG, 244 Princess St.
VANCOUVER. B.C., 217 Columbia Ave.

☛ TO INSURE SATISFACTION—STATE WHERE BELT IS TO RUN ☚



BELT
TRANSMISSION
—FOR—
GENERAL USE

The belt we offer for this service is built up under the same scrutinizing care and exactness as our waterproof belt spoken of on the opposite page. Always remember the brand :—

"CLIMAX"

Because it stands for care in selecting hides, care in tannage, care in choosing and cutting the butts, care in trimming, care in cementing—care all through—a close, motherly care that ensures a perfect belt. ALWAYS the same—every foot of it!

All belts may look alike, but!—there are so many chances for makers to cheapen the cost of production---at the expense of the belt—that you must exercise care in purchasing.

Remember we have the largest and best equipped belt factory in Canada. We cut more butts per day than any other and can afford to pick and choose our butts.

AGAIN--BE BELT SENSIBLE, ORDER ONLY BELTS TANNED AND MANUFACTURED BY

Sadler & Haworth

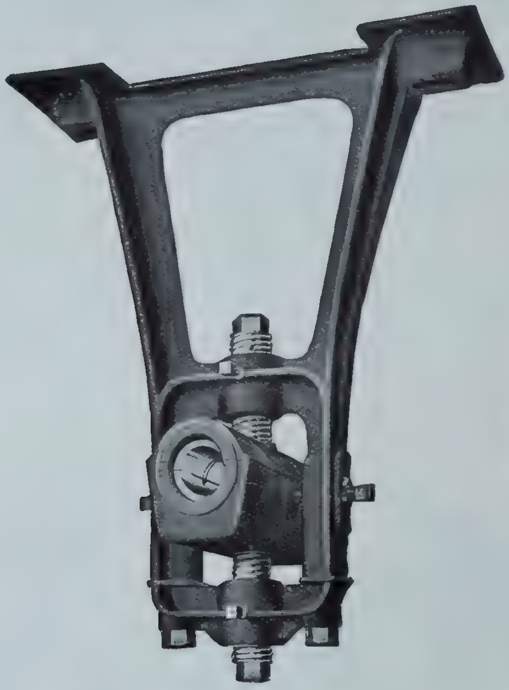
ESTABLISHED 1876

For 34 years the makers of the best belts

MONTREAL, 511 William St. **TORONTO, 27 Melinda St.**
ST. JOHN, N.B., 89 Prince William St. **WINNIPEG, 244 Princess St.** **VANCOUVER, B.C., 217 Columbia Ave.**

☛ TO INSURE SATISFACTION—STATE WHERE BELT IS TO RUN ☚

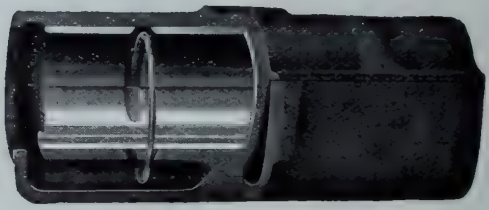
OUR
STANDARD HANGER



UNIVERSAL GIANT

WITH

RING OIL BEARINGS



NOTE the ball and socket joint between the bearing cap and adjusting screws, which permits the bearing to adjust itself to the shaft without binding.

WATCH THEM COPY IT.

MERIT—that's the REASON for it.

Fairbanks Universal Giant Ball & Socket Hangers represent the ideal in Hangers :

UNIVERSAL ADJUSTMENT—STRENGTH—SIMPLICITY

the result of careful design and application of well-known and well-tested principles.

Service Tells—that's the Final Test, and is why this hanger meets with such general success and imitation.

Our catalog on Power Transmission Appliances will tell you more about this and other Power Saving Appliances.

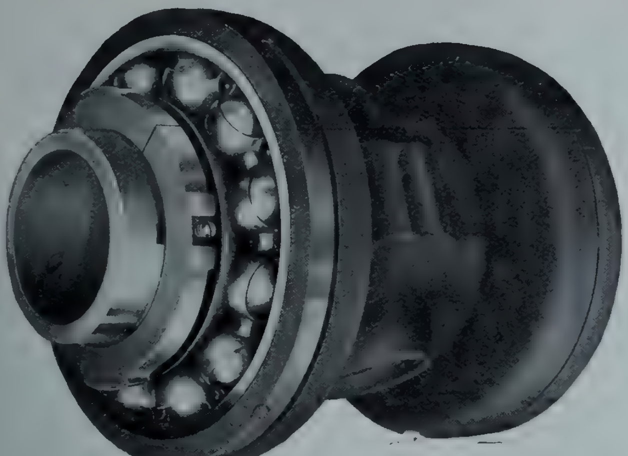
Catalog upon request.

Specialties :—DICK'S BALATA BELTING—FAIRBANKS WOOD SPLIT PULLEYS, ONEIDA STEEL SPLIT PULLEYS

The Canadian Fairbanks Co.
LIMITED

FAIRBANKS SCALES FAIRBANKS-MORSE GAS ENGINES

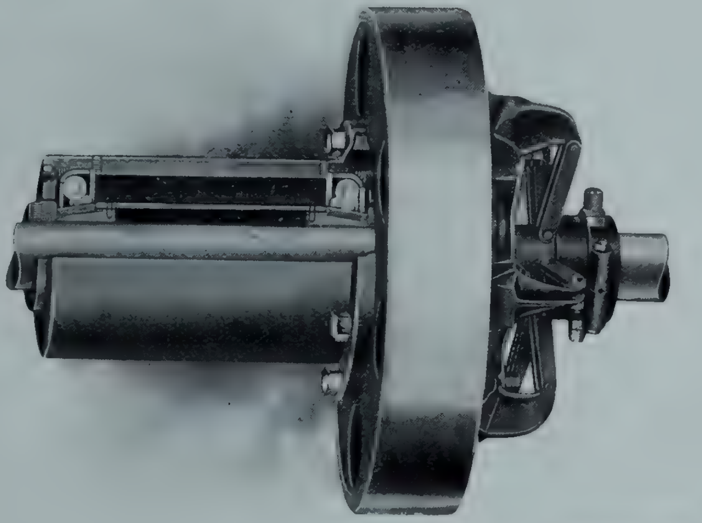
Montreal Toronto St. John, N.B. Winnipeg Calgary Vancouver



Standard
Shafting Bearing

ANTI-FRICTION BEARINGS

Illustrating the most durable and efficient type of bearing for general transmission purposes.

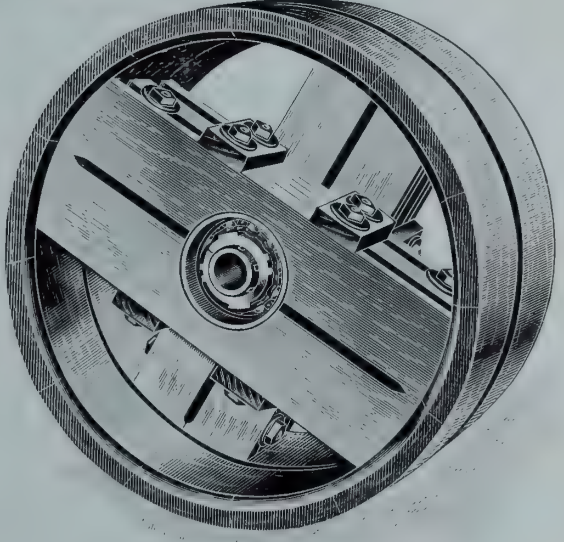


Ball-Bearing
Clutch

Write for Literature, Prices, Discounts and Results

We also make Bearings for

- Head Shafts,
- Power Table Shafting,
- Mule Stands,
- Thrust Purposes,
- Automobiles,
- Delivery Wagons,
- Carriages,
- Factory and Mill Trucks for Shop Purposes,
- Lawn Mowers, Etc.



Ball-Bearing Loose Pulley

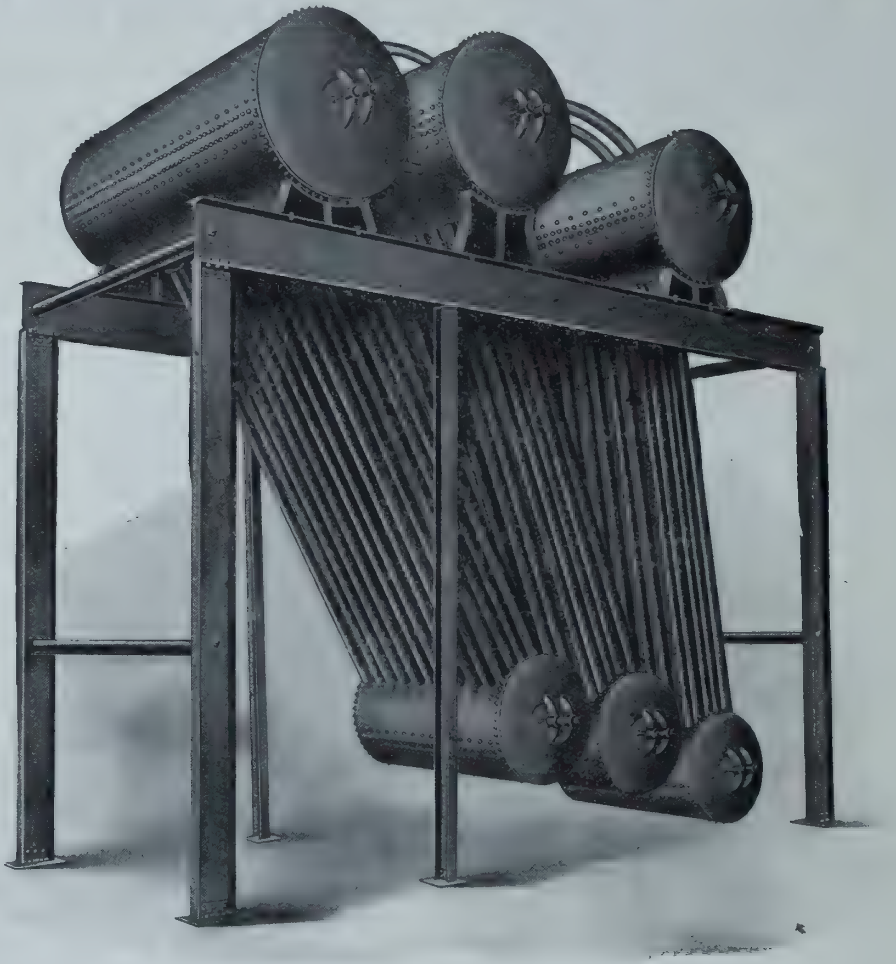
The CHAPMAN DOUBLE BALL-BEARING CO.

OF CANADA, LIMITED

347 SORAUREN AVE., - - - TORONTO, ONTARIO

Water Tube Boilers

Return Tubular, Horizontal Marine, Vertical and Portable Boilers, with or without Wheels



Side View of our NEW WATER TUBE BOILER. Not bricked in.

Our Engines, Boilers, Heaters, Pumps and Condensers are Prominent in Canada's Largest Power Houses.

The Goldie & McCulloch Co., Ltd.

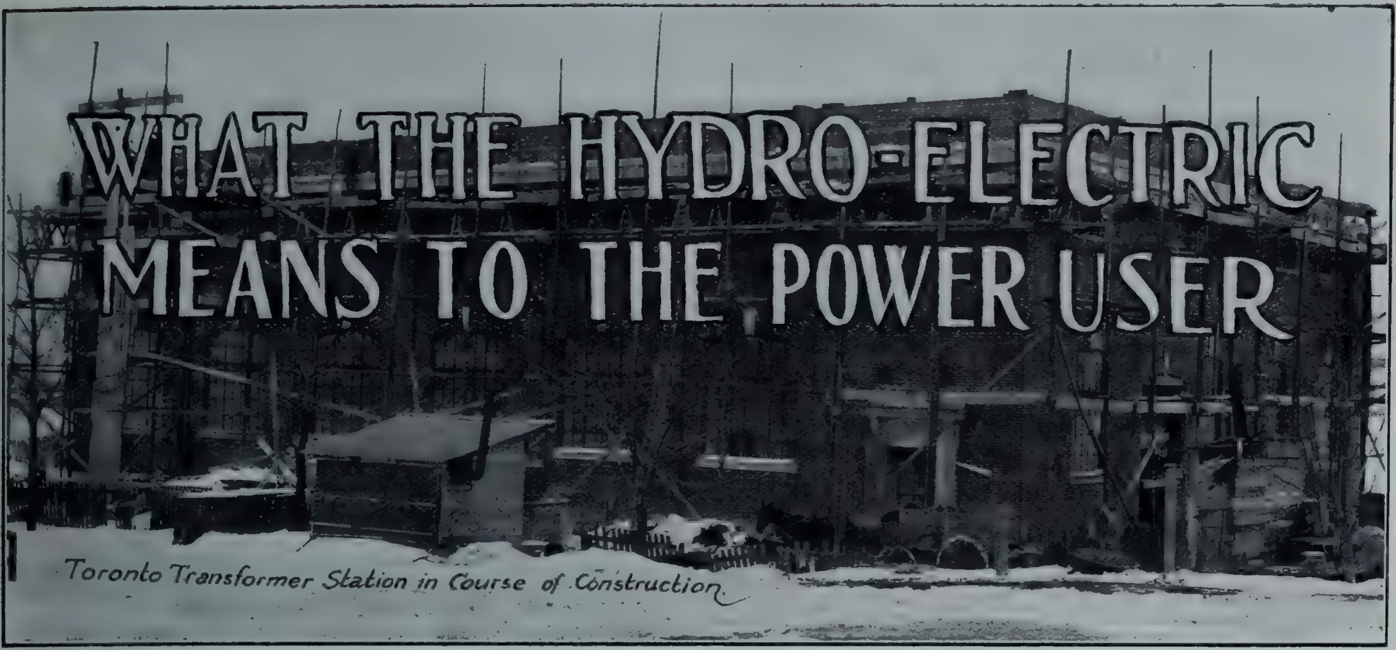
Galt, Ontario, Canada

WESTERN BRANCH	QUEBEC AGENTS	BRITISH COLUMBIA AGENTS
248 McDermott Ave., Winnipeg, Man.	Ross & Greig, Montreal, Que.	Robt. Hamilton & Co., Vancouver, B.C.

WE MAKE Wheelock Engines, Corliss Engines, Ideal Engines, Piston Valve Saw Mill Engines, Gas Engines and Producers, Boilers, Heaters, Steam and Power Pumps, Condensers, Flour Mill Machinery, Oatmeal Mill Machinery, Wood-Working Machinery, Transmission and Elevating Machinery, Safes, Vaults and Vault Doors.

Ask for Catalogues, Prices and All Information.

WHAT THE HYDRO-ELECTRIC MEANS TO THE POWER USER



Toronto Transformer Station in Course of Construction

DURING the past year engineers and manufacturers, not only of Ontario but throughout Canada, have been watching the Ontario Hydro-Electric power as a possible solution of "cheap power." To show the progress that has been made by the Hydro-Electric Commission a clear statement is here given of the layout of the line and the costs to the municipalities that have contracted for power.

The Ontario government transmission line will be ready by July 1 to supply power to western Ontario. The McGuigan Construction Co. has been busy all winter and it is expected that by that date the Hydro-Electric Commission will be able to transmit power along the lines to Dundas and from there to Toronto, Guelph, Berlin, Paris, Woodstock and probably to London.

Purchase of Power.

The commission had entered into a contract with the Ontario Power Co to purchase not less than 8,000 horsepower, and as much more as it requires up to 60,000 horsepower, for a term of ten years, with provision for three extensions for additional periods of ten years each, at the price of $9.40 per horse-power per annum up to $25,000 horse-power, and $9 per horse-power per annum if the quantity taken exceeds 25,000 horse-power, the power to be delivered to the commission at Niagara Falls at 120,000 volts, and the prices covering a 24 hours' continuous service.

The Line of Supply.

From Niagara Falls a 60,000 horse-power double transmission line will convey the current to a controlling station at Dundas, whence the line is continued east to Toronto without any intermediate station. From Dundas a double line of the same capacity and voltage—that is, 110,000 volts—is continued via Woodstock and London to St. Thomas, with local transformer stations at each point. A similar line proceeds from Dundas north and west, via Guelph, Preston, Berlin, Stratford, St. Mary's and on to London, with local transformers at each point, the whole high-voltage line comprising 300 miles. At the local transformer stations the voltage is reduced to 13,000 for the purpose of supplying by local feeder lines different municipalities in the vicinity.

Covers a Wide Range.

It is expected that the whole southwest of Ontario, from Kingston to the Georgian Bay and south, will eventually be covered, and the northeastern part of Ontario

P. W. SOTHMAN.
Chief Engineer Ontario Hydro-Electric Commission.

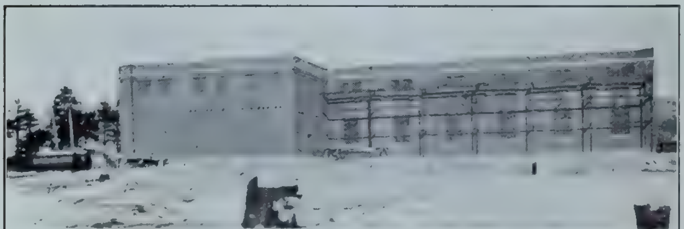
from North Bay to the St. Lawrence River will be covered by a similar system, which in due time will doubtless be established at the most appropriate generating points within the district.

Ontario Power Co.

The Ontario Power Company's plant is situated on the Canadian side of the river just below Niagara Falls. The generating station stands beneath the rocky cliff almost on a level with the river. The water used for power generation is taken from the river at a point some half-mile above the falls, and carried by an 18 foot circular, metal, conducting tube from this point, along the bank of the river to the generating station. This conduit tube supplies sufficient water for seven large turbines aggregating 80,000 h.p. A second conduit tube, also 18 feet in diameter, is at present being laid. This will double the capacity of the plant. Plans have been made to increase the capacity to 220,000 h.p. by the addition of another conduit tube.

Hydro-Electric Tower Near Dundas Transformer Station — Fastening Insulators to Top Arm.

At Niagara the commission have erected a large transforming station of 60,000 h.p. Electric power is delivered at the transformer station through an underground conduit at 12,000 volts. This being stepped up to 110,000 volts.



Hydro-Electric Transformer Station at Dundas.

Hydro-Electric Tower Showing Dundas Transformer Station—Fastening Insulators to Tower.

Distribution.

The present arrangements of the commission include the supplying of the following municipal corporations with their respective needs approximating 30,000 horse power over the lines now under construction.

Corporation—	H.P.	Price.
Toronto	10,000	$18.10
London	5,000	23.50
Guelph	2,500	24.00
St. Thomas	1,500	26.50
Woodstock	1,200	23.00
Galt	1,200	22.00
Hamilton	1,000	17.50
Stratford	1,000	24.50
Berlin	1,000	24.00
Waterloo	685	24.50
Preston	600	23.50
St. Mary's	500	29.50
Paris	500	
Ingersoll	500	
Brampton	500	
Tilsonburg	500	30.50
Hespeler	400	26.00
New Hamburg	250	29.50
Norwich	150	30.00

To these prices will be added the respective distributing costs. As other municipalities enter into contracts with the commission, these prices will probably be lower than those quoted. All the prices for equipment for towers, transmission line, transformer stationers, etc., are within the estimates so that a reduction may be possible.

The centre of the distributing system is at Dundas, seven miles from Hamilton. From the generating station to Dundas the current is carried by No. 0000 B & S aluminum cables. From Dundas out, east to Toronto and west to St. Thomas, London, Stratford, etc., the cables are No. 000 B & S aluminum. The total length of the line being installed at present is about 290 miles. As indicated in the map, ther is a double transmission line, consisting of two sets of three cables each, carried by a single row of double circuit towers, from Niagara Falls to Dundas and from Dundas to Toronto. The line from Dundas to Stratford by the upper route and from Dundas to London and St. Thomas by the lower route is a single circuit three cable line as yet, but provision has been made for doubling the capacity of this line in that all towers installed on this section are also double circuit towers. From Stratford to London the line is equipped for single circuit only.

Hydro-Electric Tower Showing the Comparative Size.

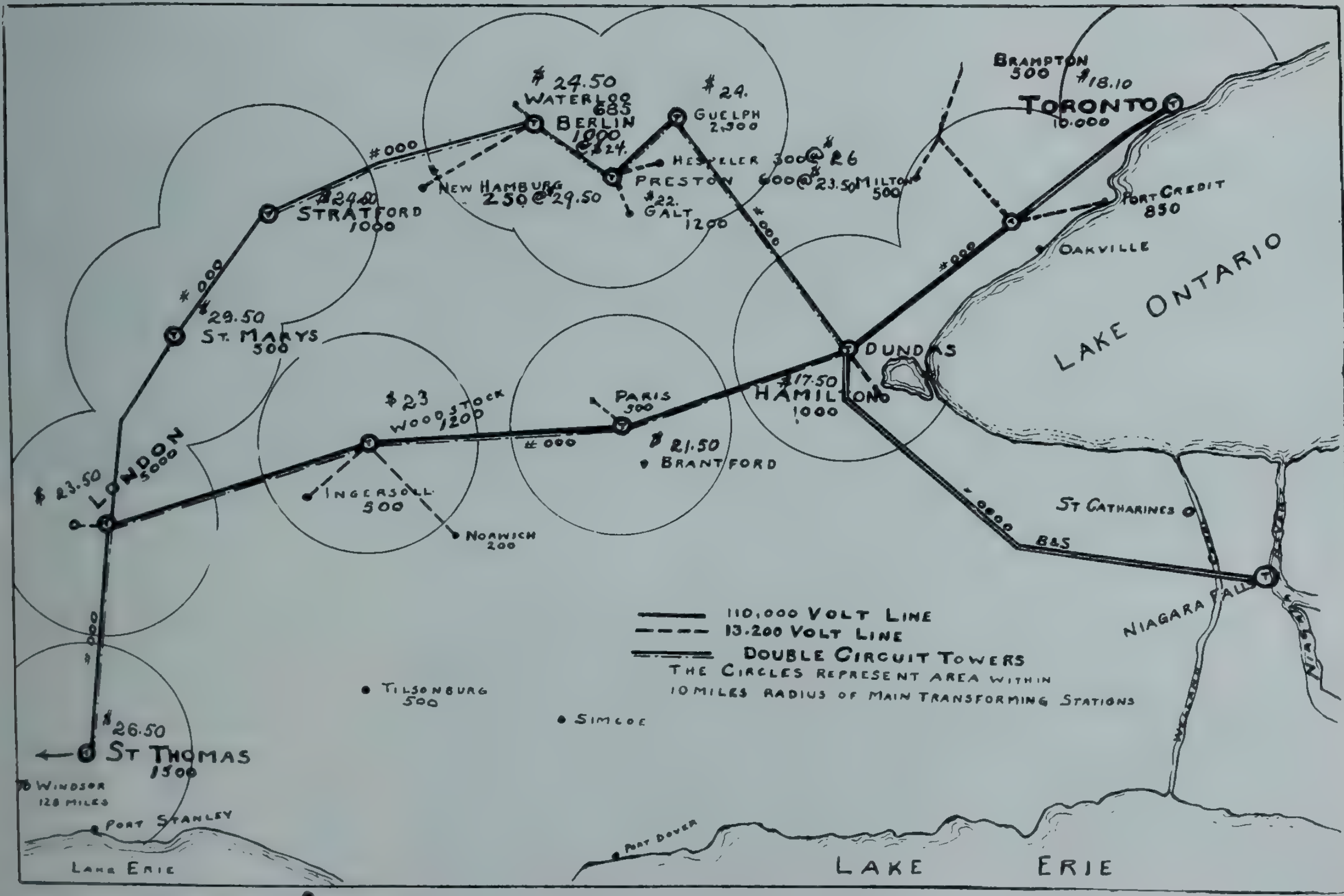
◆

C. A. S. E. 1910 CONVENTION.

Preparations are being made to make the Twenty-First Annual Convention of the Canadian Association of Stationary Engineers in Berlin the greatest ever. Although the date is July 26, 27 and 28, the officers of the C. A. S. E. and C.A.S.E. Exhibitors' Association are busy making preparations for the event.

Two new departures are being made this year which will greatly increase the value of the convention. In addition to the large and varied exhibits of power equipment and supplies, arrangements are being made for the reading of papers, of interest to engineers, by authorities in their lines. Among these are H. L. Peiler, of Peiler & McKenzie, Montreal, A. W. Spotton, of the Goldie & McCulloch, Galt and A. M. Wickens.

At previous conventions it was the custom for the elected representatives only to attend. The growing importance of the convention with the two valuable features, the papers and the exhibits, are being recognized, and letters will be mailed to the proprietors of factories asking that their engineer be allowed to attend the convention. Business will be transacted as before by the elected representatives, but the educative features of the convention will be sufficient to more than repay every engineer who attends. Many new ideas will be gleaned from the discussion of the papers read ; he will see first hand the latest ideas in engineering practice and will rub shoulders in a social way with his brother engineers.



Map Showing the Transmission Lines and Towns that Have Made Contracts with the Hydro-Electric Commission.

The Evolution of a Leather Belt

By F. C. DOUGLAS WILKES, B.Sc.

WHEN one thinks of the transmission of power throughout a plant, from engine to dynamo, from motor to machine, one's thoughts logically trend towards a belt of some description. Sometimes this is a chain belt, sometimes one of rope or cotton, but most generally it is of leather. On the other hand, how often do one's thoughts go beyond the consideration of the finished belt, how often do we, in thinking of it, go farther and imagine the belt in its construction stages? In nine cases out of ten our thoughts stop at the end of this construction and little or no consideration is paid to the whys and wherefores of good and bad leather belts. It is the object of this article to brifly outline the various stages through which a good belt passes on its way from the back of the animal to the pulley of the user.

As a starting point we will consider the source of hides used in making leather belts. Most of us realize that these come from the backs of cattle. This is true, but in an extremely general sense. There are millions of cattle slaughtered every year throughout the world, but only the hides of a very small per centage of these eventually go to make a leather belt. None of these hides are wasted, all go to make leather of some description, but the requirements of an A1 leather belt are such that only the small percentage mentioned will meet all of them.

There are, so to speak, three subdivisions to the class "cattle," viz., bulls, cows and steers. In every case those hides which are trimmed and tanned for belt manufacture—called belting butts—come from the backs of steers, the hides of bulls and cows are never used. Even those from the steers vary somewhat as to desirability. For instance the best age of the steer from which the most satisfactory butt is obtained is between three and four years and the animal should be killed in the middle fall because at this season the winter coat is being taken on and the hide is heavier and in better condition, and it is also freest from insects and grubs at this time. The wild or range fed steer yields a better hide than does his stall fed or distillery fed brother, because he is in better muscular condition owing to his freedom and activity.

The hide of a bull is unsuitable for belting purpose on account of the unevenness or variation in the thickness and the fact that it is coarse and hard. On the other hand the hide of a cow is thin, also varies in thickness and the fibrous nature is so open and weak as to be unsuitable for belts.

Tanning the Leather.

The hides, after coming from the abattoirs, pass into the hands of the hide dealers who "cure" them and in turn dispose of them to the tanneries.

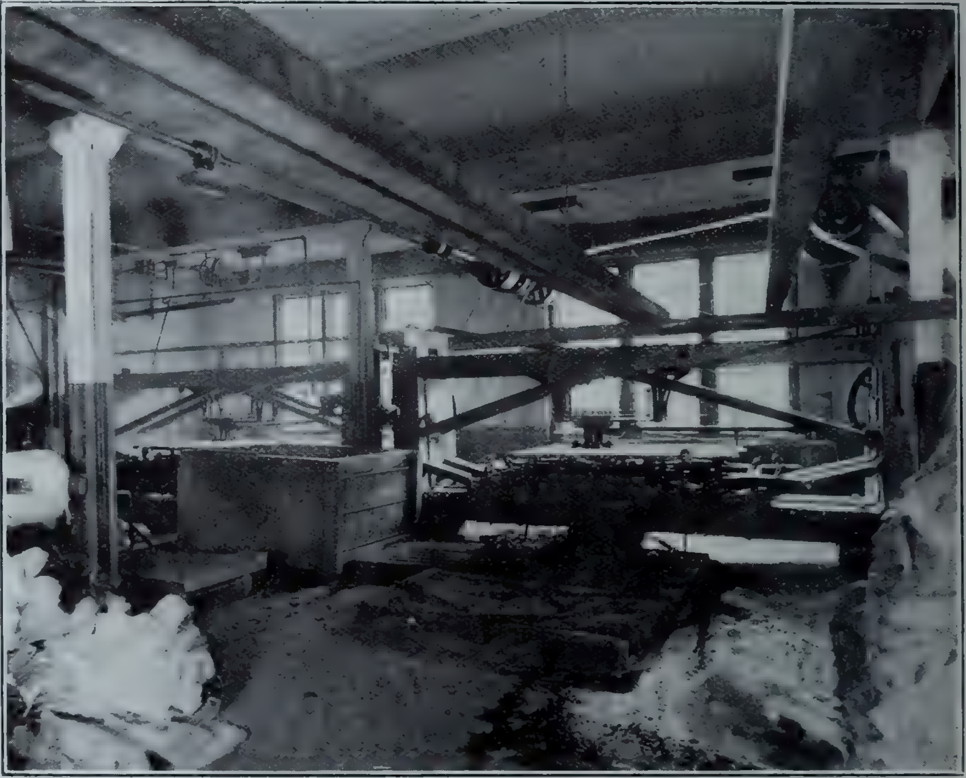


Fig. 1.—Scouring Machine—The Leather is Laid on the Table and the Scouring Stones are Carried in that Part of the Machine Shown in the Centre Under the Beam.

The tanning process is probably the most important stage of the belt's evolution after the selection of the very best steers' hides. I put the selection of the hides of first importance because no amount of care in tanning can make a good belting butt out of a poor hide.

The natural desire of modern commerce is to devise means for the acceleration of production and this has been felt even in those processes which are performed by nature. This endeavor has been applied to the process of tanning leather by substituting vegetable and chemical products for tan bark. The results have been sadly disappointing and no method has yet been brought forward that can beat the slow and sure process of nature working through its agent—natural tan bark. There are two sources of tan-bark, the oak and the hemlock trees and, of the two, the oak is the better. The difference of quality in the leathers produced by these two agents may be well illustrated by the comparison of the quality of the wood from the two trees.

Parts of even the best hide are unsuitable for belting. These are the necks, bellies and flanks which are cut off leaving what is termed the belting butt ready to start the tanning process. The first step consists in the thorough washing of the hides to remove the dirt accumulation, when they are treated to a bath of a lime solution. This loosens the hair and the

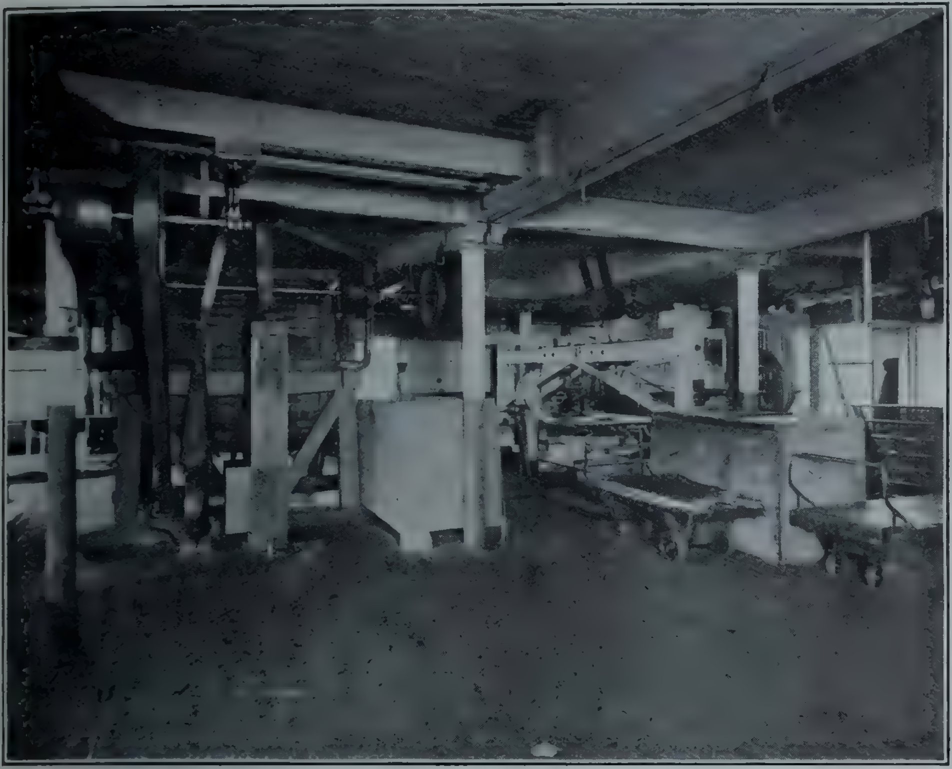


Fig. 2.—The Machine Shown in the Right Background is a "Setting Out" Machine. The Apparatus in the Left Foreground is the Hot Wheel Where the Animal Greases are Mixed With the Leather.

flesh adhering to the hide so that afterwards, when the hides are put on "the beam," these undesirable parts are easily removed. They are thrown over the beam and the hair and flesh scraped off with a knife by hand and although there have been many attempts at designing a machine to do this work satisfactorily there is little or no advantage to the machine as compared with the hand process. The lime is then taken out of the hides in "the bate," and after passing once more through the wash wheel they are ready for the tanning pits.

Here it is where there is some temptation to sacrifice the quality of the leather to the time consumed in tannage. The old slow process consuming months in operation is the best, but the difficulty is that it ties up the tanner's capital (represented in hides undergoing tannage) for so long and again the hide market may drop resulting in a loss to him who has to buy so far in advance of delivery. The temptation referred to is to use chemicals other than the tannic acid from oak bark or to employ extracts of hemlock with the oak.

The tanning vats are usually level with the floor of the tannery and are constructed of wood or are wooden lined. In these vats the hides are laid out flat and over each layer is spread ground oak bark. When full of hides each vat is filled with a solution of tanning liquid. This varies in strength in the various vats from weak to strong and the hides are gradually changed from one vat to another from weak to stronger liquid, until thoroughly impregnated. When the hides are changed they are laid out with fresh bark each time. After being dried and treated to an application of oil (cod oil is the best) the butts are ready for the belt manufacturer.

Choosing and Cutting the Butts.

Even though each butt that comes to the manufacturer is a perfect butt considerable care and judgment must be exercised in choosing the portions that go to make up any one belt so that when finished it will run true and straight. To the uninitiated all butts look alike and the buyer of a good belt little knows the care that is taken in selecting the leather so that the belt will be uniform throughout as to thickness, evenness of texture, uniformity of stretch and wear. The best portion of the butt is, of course, the centre. Here it is where the vitality is greatest owing to the proximity to the spine and its network of nerves, which, radiating outwards become less dense towards the edge and consequently less influential. For the same reason the fibrous nature of the hide is more dense and firmly knit at the centre. A belt made from the centre of a butt will run truer on a pulley by virtue of the evenness of distribution of the fibres on either side of the spine which serves as a guide. The best manufacturers make it a point to select and cut the butts so that the parts forming the same size belts are always cut from the same part of every butt. This is done because the outer portions of the butts which are less and less dense as they are farther from the centre, will stretch more than the portions nearer the centre. Choosing them always from

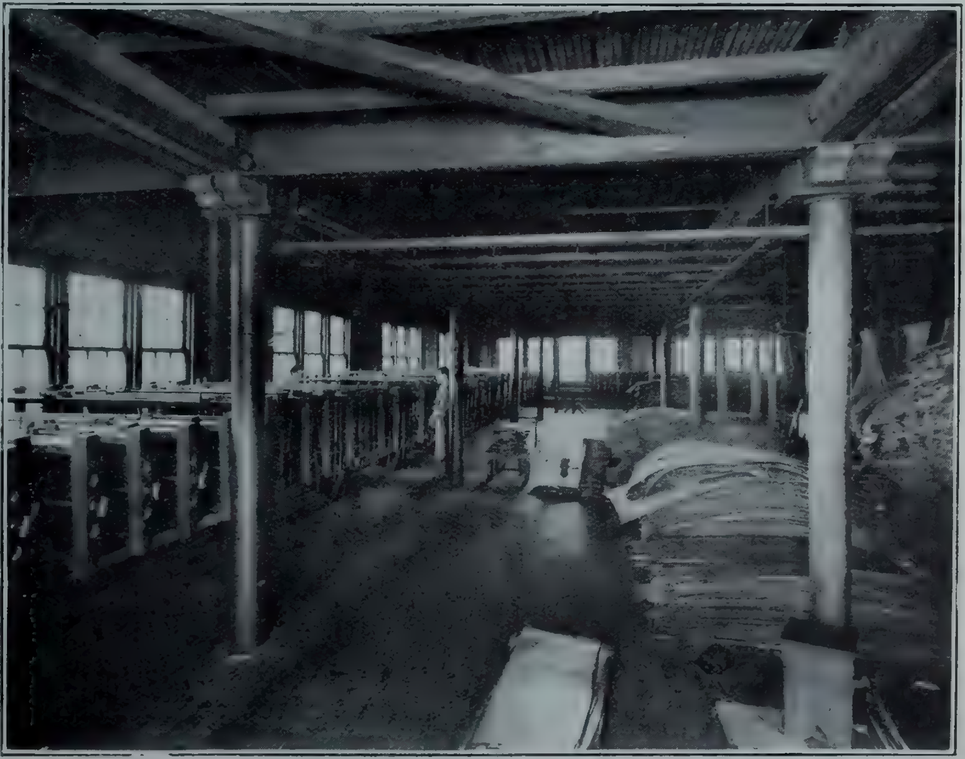


Fig. 3.—Part of the Seasoning and Stretching Floor. The Clamps are Shown in the Racks at the Left of the Photo.

the same spots will ensure, as far as possible, the stretch of the belt being uniform and it is less liable to wobble and run out of true.

Making the Belt.

The butt is first cut into three strips, the centre and the two sides. These then go to the fleshing machine which removes all the particles of tanned flesh that still adhere to the butt. This machine carries a very rapidly revolving knife, shaped something like a worm gear, which is passed to and from over the leather and unerringly shaves off the flesh without the least injury to the grain. This operation used to be done by hand by laying the leather over a beam and scraping it with a two handled knife. This method was at once laborious and unsatisfactory as to results. The machine does in a couple of hours what would consume a week if done by hand.

After the fleshing machine the leather is washed and put on the table of the scouring machine. Here it is scoured by an ingenious motion whose action most closely resembles the movement of the human hand and wrist. The smooth scouring stones work to and fro over the leather smoothing out the bagginess and removing any foreign substance which may be adhering. If not entirely free from this foreign matter before manufacture the belt is very liable to crack when put to any ordinary continued strain of service.

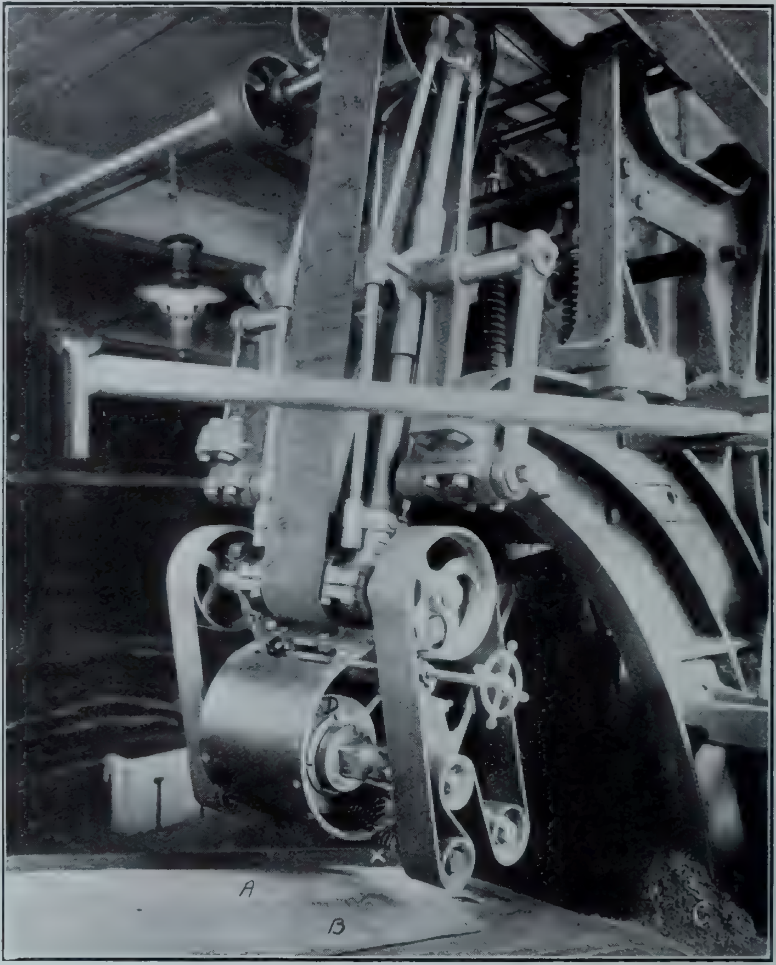


Fig. 5.—Moving Arm of Fleshing Machine; A is Part of Hide Which has been Fleshed; B is Part of Hide to be Fleshed; C is a Pile of Fleshings; D is Emery Wheel which Automatically Sharpens the Knife Shown Just Above X.

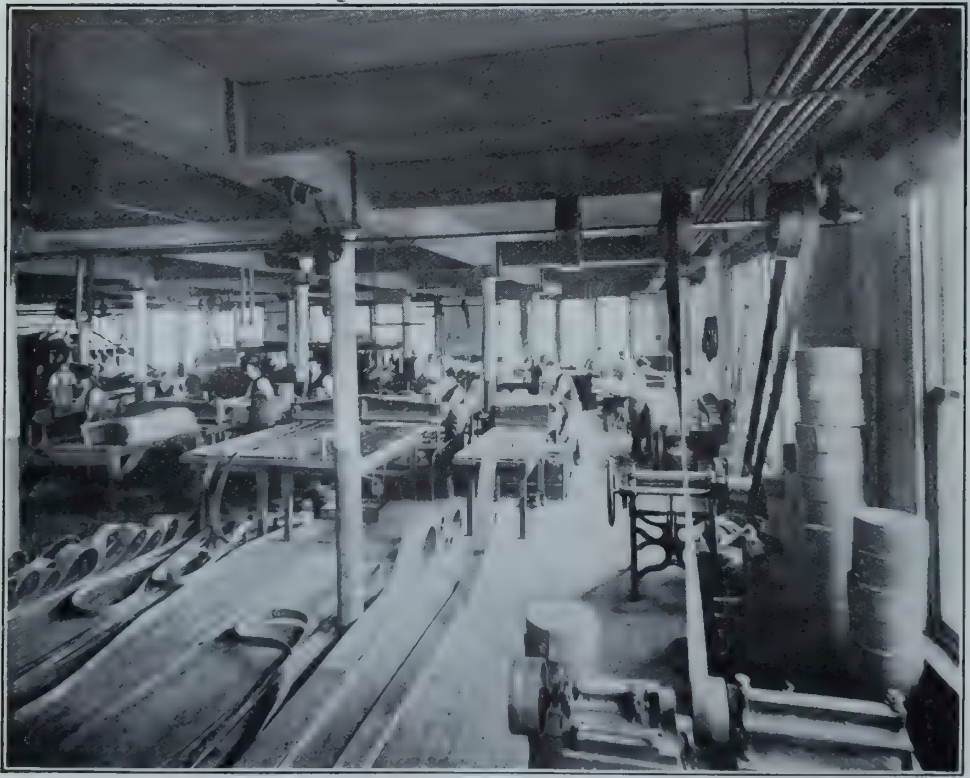


Fig. 4.—Building the Belt. This Picture Shows the Type of Table and Hydraulic Presses Used.

From the scouring machine the leather is treated with greases composed of pure animal oils, and these are thoroughly worked into it. The strips are first put into a hot box in which the pores are opened, similar to the way the human skin will open. From the hot box they are put into the hot wheel with the greases and tumbled about until all that is possible is absorbed. Some makers hold that to work the greases in cold is the best way as the way spoken of above works an excess of grease into the leather. It may be stated here that this applies to hides or leather having a short fibrous nature. These have to be treated cold and cannot be handled as can the long-fibred hides of our northern-bred steers. The reason for impregnating the leather with grease is obvious. It oils the fibres so that there will be less friction between them at work and less wear—for the same reason that a journal is oiled or a chain.

The strips then go to the setting-out machine. This acts like a massage on the leather, working in the necessary grease and rubbing off the surplus. The machine works on the same principle as the scourer, and the strip is so arranged that the rub is in the direction of the shoulder. This lays the leather out flat and condenses its fibres, reducing the thickness somewhat. The strips are then "glassed out" by hand, which operation consists of working the leather with the edge of a piece of glass, and is merely a cleaning operation to remove the excess grease left by the setting-out machine.

The leather is then hung up and left for a few days before being put into the stretching clamps. Here may be mentioned the reason for removing the centres of the butts. Unless these are removed there is no way in which the leather may be stretched, so that the slack is evenly taken up. A little consideration will make this clear; the backbone of a hide is the least elastic part of the whole and is so stretched during the life of the steer that there is little stretch left after the tanning process. The leather gets thicker and more porous towards the outside edges of the butt, and therefore this part stretches much more readily than the centres, so that if a strip contained part of the centre and part of the side it is obvious that it would not stretch uniformly.

There are a few methods in use in which the leather is stretched by other means than by clamps, but none have proven as satisfactory, nor as thorough as the old clamping method. In this the leather is held by two pair of clamps, which are moved apart by set screws or ratchet until the desired tension is exerted on the belt. The strips are left in the stretchers until bone dry.

When removed from the clamps each end has indented marks, which are cut off, and the leather is then slightly moistened and left to season. This moistening allows the leather to creep back just a little, making it flexible and elastic to a degree sufficient to grip and adhere to the pulleys with the greatest efficiency.

The different sizes are now sorted, piled up and left for about three months to season before going to the cutting machines, where they are cut into strips, which represent all the different sizes the maker puts on the market. When it is remembered that strips for similar width belting all come from the same part of the butt it is readily seen that the cutter must be an expert to be able to cut and mark these pieces so that there will be, so to speak, no mixture of strips. The different widths are taken out according to the characteristics which the leather shows—that is, the denseness, thickness, etc. As was explained above, near the centre the leather is thinnest, and the thickness gradually increases towards the outside. It may be that a strip two inches wide may be taken off without any appreciable difference in thickness in the two edges, but if the slope is pronounced, a thinner slip must be taken. Herein lies the need of fine discrimination on the part of the cutter, and no hard and fast rules may be laid down for him.

These strips are all sorted and if not immediately needed for orders in hand they are filed away. Here again the discrimination of the sorter is put to the test because whether or not the belt runs true with uniform thickness and strength depends upon the way he matches the strips to be used in that belt. Uniform thickness is the principal feature that he must decide upon, and his practiced eye will detect a variation which the uninitiated would seach for in vain. The greatest differences in thickness appear at the shoulder, and this fact necessitates one of the rigid rules in belt-making, which is to the effect that in putting the pieses together they must be matched shoulder to shoulder, butt to butt.

Perhaps some of our readers have noticed a wobbly belt or one which, after service, grows snaky or twisted. This has been due to laxity in matching the pieces. Every strip should have its thick side to the same side of the belt and there will be no wobbling.

The next operation is where the ends are scarfed for the lap. They are first given a roughing cut and are then passed on to the "pointer," a workman who with a scraper having a very sharp edge points down the leather to a further degree. It is then made paper thin by passing under the rapidly-revolving knife of a special machine for the purpose.

These pieces now come to the cementing table, where they are joined together by a special belting cement of extremely high adhesive properties. It requires an exceedingly skilled workman to put the pieces of a belt together properly. Should a lap be out of true, only the tiniest fraction, this would amount to inches in a long belt by the time the end was reached. The lapping, then, is a very important feature in the making of a leather belt. After the joints are cemented together they are worked down by hand and then are subjected to a heavy pressure (usually hydraulic), which makes a joint that won't tear apart nor break until after the belt itself would go. No rivets are necessary in a well-cemented belt.

If the belt is to be double, the bottom half is made first, as a single belt, and then the other half is put on. The double belts are made with the grain of the leather on both sides. From the cutting machine to the finished belt the work is all done by hand, with the exception of the scarfing machines spoken of, and the greatest friend of the beltmaker is his straight-edge, which governs every move he makes. The cement used for general purposes is not impervious to moisture, so when a belt is wanted to run in damp or moisture-laden atmosphere a special waterproof belt is used and the leather is also impregnated with a waterproof solution as a last operation before going to the user.

After the belts come from the presses they undergo a stretching process, which is tantamount to a test and shows up any weak lap. It also eliminates more or less of the stretching troubles experienced by the user of a new belt during the first few days of its service. All that remains to be done to the belt now is trim it, measure it and brand it. The belt is passed through pressure rolls past the trimming knives, which bevel the edges. The measuring wheel next takes the belt and at each revolution the brand is stamped into the leather by steel dies in the wheel. The wheel is usually an even ten feet in circumference. After being wound up, the belt is put on the buffing machine and the beveled edges given a high polish. This is the condition, and the only condition, in which most of us see a belt first, and one of the objects of this article is to acquaint the possible buyer of the procedure of good belt-making, so that when making a purchase, whether involving ten or a thousand dollars, he will be in a position to ask questions of the salesman that will tend to blow holes in his argument if trying to sell an inferior belt. "All belts look alike" is often heard, but, as is a well-known fact, all belts are not alike, and the difference lies in the manner in which the various parts are gradually brought together to a finished whole. If this article proves to be the protection it is meant to be, even in one isolated case, the writer will feel that he has been justified in having spent his time on it.

ADVANTAGES OF ROPE DRIVING.

Ropes can be used to greater advantage when driving and driven shafts are not parallel than can any other system of band or link connection. Not only when shafts are slightly out of alignment, but when in any plane and at any angle with each other, and at any distance apart, can power be more easily carried. This makes a most satisfactory way of overcoming natural obstacles or for taking advantage of opportunities not allowable with parallel shafts, especially when the driving parts cannot be protected from the weather inclemencies.

Lubrication Economies in Power Transmisson*

An Engineer who Keeps Track of Oil and is Careful in Selecting the Best Lubricant for the Purpose for which it is Used can often Eliminate a Great Deal of Friction Loss, thus Reducing Power Costs.

By William M. Davis.

IN lubrication the first consideration is efficiency, then economy. For efficient lubrication the most important thing is lubricant of good quality ; next reliable appliances for feeding the oil, so that every drop will go directly to the bearing surfaces. For slow-speed engines, ordinary sight-feed cups are satisfactory, but for heavy high-speed work a continuous oiling system is most efficient. From an economic standpoint, however, the success of such a system will depend entirely upon the means to catch the oil after it leaves the bearings.

Catching Excess of Oil From Bearings.

With slow-speed engines and all machinery that uses oil in quantities, every bearing should have substantial sheet-steel pans, arranged, if possible, to drain the oil to some central point from which it can be taken to the filter. If the engine is of the horizontal crank case type, care should be taken to keep the oil as free from water as possible, as water will sometimes travel along the piston rod into the crank case, and, if it is the least bit alkaline, as may be the case where compounds are used in the boilers, the oil and water together will sometimes form an emulsion which is hard to separate and lowers the quality of the oil. The above would not apply, of course, to the vertical steam engine, which uses water in the crank case.

To secure economical lubrication, the first thing is to stop the leaks. Every piece of machinery should be provided with drip pans to catch the oil. In a large plant where several engines are close to one another, the oil pans may be piped to a central tank, whence it can be pumped to the filter. On slow-running engines where the pressure is not excessive, and on slow-running shafting, a good grade of grease or tallow compound will often give good results, but where compression cups are used the grease should be quite soft so that it will spread freely. If too hard, great pressure will be required to feed it, and it will also tend to increase the friction load.

Where the hub of a flywheel or large gear is so close to the bearing that there is not sufficient space to fasten oil pans under the bearing all excess of oil will be lost. Such bearings can often be lubricated economically by packing a lump of medium hard grease on the journal at each end of the bearing and feeding a little oil in the middle. The grease will prevent the oil from running out too fast, and at the same time help to lubricate.

Cylinder Lubrication.

The proper amount of oil that should be used will have to be determined by experiment. A good quality of oil should be provided, and to get economical results the conditions should be made as favorable as possible—e.g., the steam should be dry ; the water in the boilers not too high ; an excess of strong alkaline boiler compounds avoided ; and, above all, the piston rings should not be set out too tight. Before putting the rings in the piston the edges should be chamfered off slightly with a file, for if they are sharp they will tend to scrape the oil from the surface. From the lubricator the discharge pipe should extend into the centre of the steam pipe, so that the oil will drop into the current of steam. Where the engine speed is constant there is little choice between a force feed pump and an ordinary sight feed lubricator. Either will give efficient and economical service if properly taken care of, but where the work is intermittent, the engine stopping and starting, the force feed pump is more economical.

To determine the proper amount of cylinder oil to use, make the conditions as favorable as possible, then gradually reduce the oil feed and note the action of the valves. If they work smoothly all right, but if they commence to groan increase the oil feed slightly. After this the cylinder head should be removed and the surface of the cylinder examined. If it looks oily, and when wiped with a piece of soft paper a stain is left on the paper, it is certain that enough oil is being used.

Receiving, Handling and Distributing.

If the plant is a large one the oil house should contain storage tanks sufficient to hold a tank car of each kind of oil. By purchasing the oil in cars there will be a saving in the price per gallon and in labor of handling the oil and empty barrels. In a small plant where only a few barrels of each kind of oil are used a month, tanks holding from 2 to 10 barrels should be provided, so arranged that the oil can flow by gravity from the barrels to the tanks. Care should be taken to see that the barrels drain out clean.

It is customary in a large plant to have a man in charge of the oil house who receives and stores all lubricants, issues and charges them up to the various departments, keeping a record of the amounts given out in a book or on suitable blank forms. To limit the daily amount of lubricants for each department, the chief engineer or master mechanic, when making his daily rounds can give each engineer an order for his day's supply of oil and grease, and thus know if the amounts required are increasing or decreasing ; or an allowance may be made each engine room or department per day or week, which cannot be exceeded except by written order to the oil house storekeeper. At the end of the month the storekeeper totals the amounts of lubricants used and obtains the total cost.

Reduction of Cost.

Nearly all plants spend more than is needed for lubrication, due partly to wasteful methods in use, partly from using unsuitable lubricants, and often to paying prices higher than necessary. The first can be greatly prevented by systematic methods of issuing the lubricants and charging them to the different departments and by installing more economical appliances.

In regard to more suitable lubricants in many plants there is often slow-speed machinery, on which it is not practicable to recover the oil used, in which case a good grade of dark lubricating or black oil will often answer as well as the more expensive oils. A works that was using large quantities of an expensive grade of cylinder oil on its machinery where a heavy machine oil would have answered equally as well could have effected a saving amounting to over $2,000 a year.

To purchase good lubricants at the lowest prices, it is best to buy on specifications, asking bids and awarding a contract for a year's supply to the lowest responsible bidder.

HORSE POWER OF BELTING.

A simple rule for ascertaining transmitting power of belting, without first computing speed per minute that it travels, is as follows : Multiply diameter of pulley in inches by its number of revolutions per minute, and this product by width of the belt in inches ; divide this product by 3,000 for single belt, or by 2,100 for double belt, and the quotient will be the amount of horse-power that can be safely transmitted.

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* Abstract of paper read before Boston Society of Civil Engineers.

Transmission Appliances That Prevent Power Loss

Power Lost in Friction is often a Large Item and means a Great Increase in Fuel Bill—If Friction is Reduced it means that Profits are Increased.

By W. E. Cane*

In these days of keen competition in the manufacturing industries, a factory manager is always on the lookout for anything which will reduce the cost of manufacture, or in other words to put a stop to all unnecessary expense in connection with the production of his goods, and thereby be enabled to utilize all of his available energy and working capital in the direct production of his goods. In his efforts to reduce his expense he will first of all carefully analyze the efficiency of his staff, and if necessary take proper steps to bring it up to and keep it at a maximum state of efficiency. Next, he will carefully scrutinize his equipment in regard to facilities for handling material and process through the works, machines for performing their allotted duties, and also his whole power plant equipment, and if he sees an opening for reducing power consumption or increasing the output by changing or by additional appliances, he will naturally get busy and adopt the most up-to-date and efficient means that can be procured, always keeping the first cost a secondary consideration when he is assured that he will regain it within a reasonable time.

How many manufacturers we see today who originally started with an ordinary fire tube and hand fired boiler and plain slide valve engine, but have developed a power plant that would (if still a steam plant), have among other up-to-date and efficient equipment, water tube boilers with automatic stokers, smoke consumers, feed water regulators, superheaters, oil and water extractors, hot well, mechanical draft, etc., and at the same time using a grade of fuel that it was formerly impossible to get results with. All of this in order to reduce the cost of production of the steam to be delivered to his engine. He will also have a most efficient engine condenser, lubricator, and any other devices that tend to reduce the total cost of and uninterrupted supply of power delivered to his line and countershafting.

In a large percentage of otherwise highly efficient factories the lines and countershafts have been overlooked altogether in regard to their faculty to waste power. This waste power will amount to from 14 per cent. to 80 per cent. of the entire power delivered by the engine or other prime mover (this statement is borne out by actual tests which have been made here in Canada and also by a report shown in the table No. 1, this report being an extract of a paper read by Prof. C. H. Benjamin before the American Society of Mechanical Engineers, 1896), unless the shafting equipment is brought up to as high a state of efficiency as possible. If this is done the losses of power in the shafting will not be more than 25 per cent. of what they formerly were, leaving 75 per cent. of the power formerly going to waste to be applied to the machines and thereby increase their output, or else on the other hand, reduce the total amount of the power consumed for a given amount of output.

FRICTION HORSE-POWER IN FACTORIES.

Prof. C. H. Benjamin, Trans. Am. S. M. E., 1896-7, p. 228.

No.	NATURE OF WORK.	Total Length of Line Shaft in Feet	Diameters of Line Shaft	R. P. M.	No. of Bearings.	Total Horse-Power	H. P. to Drive Machines.	H. P. to Drive Shafting	Per Cent. to Drive Shafting	Per Cent. of Full Load.
1	Wire Drawing and Polishing	1130	2½, 3¾, 4, 6″	170	115	400	243	157	39.2	50
2	Steel Stamping and Polishing	580	3, 3½″	200	68	74	17	57	77	35
3	Boiler and Machine Work	1530	2½, 3″	150	46	38.6	13.3	25.3	65.6	65
4	Bridge Machinery	1460	2½, 3, 4″	110	142	59.2	11.3	47.9	80.7	90
5	Heavy Machine Work	1130	3″	190	110	112	48	64	57	100
6	Heavy Machine Work	1065	2, 3, 4″	180 to 150	114	168	77	91	54.2	100
7	Light Machine Work	748	1½, 1¾, 2, 3″	135 to 150	101	40.4	19.7	20.7	51.2	100
8	Manufacturers of Small Tools	500	2, 3″	114	58	74.3	34.3	40	53.8	100
9	Manufacturers of Small Tools	900	2½, 1¾″	175 to 136	102	47.2	22.7	24.5	51.8	100
10	Sewing Machines and Bicycles	2490	2, 6″	150	274	190	82	108	56.9	100
11	Sewing Machines	1470	2, 3, 4″	160 to 125	184	107	32.5	74.5	69.7	100
12	Screw Machines and Screws	1800	2, 2¼, 2½, 3″	180	180	241	127	114	47.3	100
13	Steel Wood Screws	674	1½, 2, 3″	160 to 175	96	117	100	17	14.5	25
14	Manufacturers of Steel Nails	988	2½″	200	74	91.6	45.9	45.7	49.9	100
15	Planing Mill	165	3″	267	19	39.2	10.6	28.6	73	100
16	Light Machine Work	275	2″	175	37	8.3	4.3	4.0	48.6	50

These fact when brought to the attention of the manufacturer are invariably startling, and on first consideration seem to be impossible, but when he has made a thorough investigation of the power losses in his plant due to inefficiently equipped shafting, it does not take him very long to decide the proper course to pursue.

Power Losses.

There are three great factors entering into the losses of power during its transmission from the prime mover to the machinery, namely:—

1. Losses due to the use of belts that are too narrow and consequently have to be run so tight that they reduce the torque of the driving and driven shaft by increasing the load or pressure on the bearing, consequently causing unnecessary friction, (waste power), and at the same time shortening the life of the belt and bearing. The use of a wider belt or preferably larger pulleys (if the belt speed is not up to its most efficient point), will immediately remove this trouble.

2. Losses due to the shafting being out of line or being too light, and not sufficiently supported to take the necessary strain off the belts without abnormal deflection. The maximum amount of deflection should not exceed one hundredth of an inch per foot of length. Any deflection in excess of this will increase the power losses. Anyone can readily demonstrate the losses of power due to abnormal deflection of shafting by taking a piece of bent or sprung shafting and supporting it at each end, and springing it until it is true. Power lost will be equivalent to power required to spring the shafting back to its normal position. This condition of shafting results in the loss of power and very often eventually of broken shafting. Therefore, it is absolutely necessary that the shafting be kept in line and properly supported.

3. Results of both of the foregoing conditions impose abnormal loads or pressure on the shaft bearings, which ordinarily are by far a greater consumer of power than either the belts or sprung shafts, and also necessitate a liberal supply of oil and attention to say nothing of the danger due to hot boxes.

The most efficient way of overcoming these power losses, etc., in the bearings is by the use of ball bearings. These bearings have demonstrated in hundreds of Canadian factories (during the last six years) that they not only save 95 per cent. of the oil and attention required by babbitted bearings, but also save over 75 per cent. of the power consumed by the babbitted bearings, and eliminate entirely the danger of a hot bearing.

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* Superintendent Chapman Double Ball Bearing Co., Toronto.

Loose Pulley.

Another common power consumer and dangerous appliance is the ordinary loose pulley. It is next to impossible to keep it properly lubricated, and it is very liable to receive no attention whatever until it begins to growl to such an extent that someone has their attention called to it, and it is then given an injection of lubricant and nursed until it is apparently safe to leave it alone. It often catches fire before it is attended to and then all the employes in the department have their attention attracted during the whole time taken to shut down and take it off, or while it is being “doctored,” whereas the use of a ball bearing pulley would have prevented any of the trouble and done its duty for years without any more than fifteen minutes attention per year, and the floors, walls, ceiling, etc., would not have been splattered all over with dirty oil, to say nothing of the fact that it is not necessary to keep the material (in process), and individuals out of the firing line.

All that has been said in regard to loose pulleys also applies with even greater force to all kinds of friction clutches that are not equipped with ball bearings, for in addition to the fire danger, etc. (enumerated above in regard to loose pulleys), clutches have a very uncomfortable habit of seizing to the shaft and starting the machinery or machine just when least expected. With a ball bearing sleeve on your clutch it is an utter impossibility for the clutch to start before you want it to; and another thing it will stop when you want it to.

When a manufacturer goes into the market to purchase a machine or power plant he, of course, wants the most efficient machine or plant that is produced, and if the increased efficiency (that is its ratio of output in relation to the consumption of energy), is far enough in advance of its competitor to warrant the increased initial cost, he will invariably decide on and purchase the most efficient machine or plant.

Naturally ball bearings are far more expensive initially than the ordinary journal box, owing to the necessary employment of highly skilled mechanics and the highest grade of material and tools in the course of their manufacture. The same thing may be said also regarding a cheap, inefficient and practically obsolete old-time power plant compared with the more expensive but most efficient power plant of to-day. The extra cost of instalation is warranted in one as well as the other, for is it not as necessary to save the power wasted by the use of ordinary bearings (and which has cost so much to produce by means of the most effiicient power plant with its high initial cost), as it is to save the steam or water and fuel required by the engine (or current required by the motor), to deliver the power to the shafting.

Owing to the fact that ball bearings do save over 75 per cent. of the power consumed by ordinary journal bearings (which amounts to from 14 per cent. to 80 per cent. of the entire power delivered to the shafting), and at the same time (when properly made and installed), are even more durable than any other type of bearing, it, therefore, behooves the manufacturer who wants to economize on the cost of production to thoroughly investigate his present conditions regarding his shafting losses, and then take immediate steps to reduce them to the minimum by the instalation of the most efficient type of bearings.

COST OF POWER.

The accompanying table shows the cost of power in a number of Canadian cities. The tabulated figures are based on the various quantities of power used, whether 50, 100 or 1,000 k.w. is used.

The tables give the rates and discounts and where several rates are in force these are given. In Quebec there is a smaller discount given in summer than in winter. In Hamilton the light is charged at a certain rate per lamp plus so much per actual current consumed and then a sliding scale of charges and discounts on this, besides meter rental charges. The rates for Hamilton are not included in the list.

There will probably be some changes in the rates for London and Toronto when the Hydro-Electric Commission line is ready for the transmission of power from Niagara. It is expected that this will be early in July.

RUBBER BELTING.

The advantages claimed for rubber belting are perfect uniformity in width and thickness; it will endure a great degree of heat and cold without injury; it is also specially adapted for use in damp or wet places, or where exposed to the action of steam; it is very durable and has great tensile strength, and when adjusted for service has little liability to slip.

Rubber belts will be improved, and their durability increased by putting on with a brush, and letting dry, a composition made of equal parts of red lead, black lead, French yellow and litharge, mixed with boiled linseed oil and japan enough to make it dry quickly. The effect of this will be to produce a finely polished surface. If, from dust or other cause, the belt should slip, it should be lightly moistened on the side next the pulley with boiled linseed oil. Never use animal oil or grease on rubber belts as it will greatly injure and soon destroy them.

The horse power of a 4-ply rubber belt=(length of arc of contact on smaller pulley in feet × width of belt in inches × r.p.m.) ÷ 325. For a 5-ply belt multiply by 1 1-3, for a 6-ply by 1 2-3, for a 7-ply by 2, and for an 8-ply by 2 1-3. When the arc of contact is 180 degrees, h.p. of a 4-ply belt=width in ins. × velocity in ft. per min. ÷ 650.

COMPARISON OF COMMERCIAL LIGHTING CHARGES IN PRINCIPAL CITIES OF CANADA.

	50 K. W. Hours			100 K. W. Hours			1000 K. W. Hours			
City	rate	disc.	net bill	rate	disc.	net bill	rate	disc.	net bill	Remarks
Quebec	15	33 1-3	$5.00	15	33 1-3	$10.00	15	33 1-3	$100.00	Business rate
	15	20	6.00	15	20	12.00	15	20	120.00	Residence, summer
	15	33 1-3	5.00	15	33 1-3	10.00	15	33 1-3	100.00	Residence, winter
Sherbrooke	10	5	4.75	10	5	9.50	10	5	95.00	
Kingston	10	none	5.00	10	none	10.00	10	none	100.00	10 p.c. added if not paid within month
London	9	none	4.50	9	none	9.00	8	none	80.00	
Ottawa	8	10	3.60	8	10	7.20	8	10	72.00	
Toronto	20	40	6.00	20	40	12.00	20	40	120.00	Business rate
	20	60	4.00	20	60	8.00	20	60	80.00	Residence rate
Vancouver	11	20	4.30	10 & 11	20	8.40	11 to 7	20	66.00	
St. John, N. B.	15	10	6.75	15	33 1-3	10.00	15	33 1-3	100.00	
Halifax	15	10	6.75	15	12 1-2	13.13	15	33 1-3	100.00	
Victoria	13 to 11	1 c.p. K.W.	5.80	13 to 11	1 c.p. K.W.	10.80	9	1 c.p. K.W.	91.80	
Montreal	15	10	5.85	15	20	9.60	15	50	75.00	
Winnipeg	10	10	4.50	10	10	9.00	10	25	75.00	

Lacing, Splicing and Fastening Belts

By GORDON C. KEITH

THERE has been a demand for information on belt lacing by engineers. Numerous devices, in addition to leather lacing, are on the market and the engineer and the operator finds himself at a loss when belts are placed under his care.

The lacing of a belt should have the same or greater attention than is given to the details of other equipment. At present there is little written of proper methods for fastening belts, but those, whose duty it is to fasten belts, should gain all the knowledge they can on the subject.

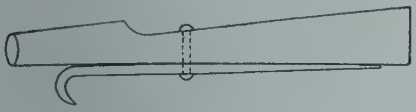


Fig. 1.—Punch With Hook Attachment.

Examine a belt laced by one who has not had proper instruction in the work. The edges of the belt are not cut at right-angles to the side and in many cases the belt is laced, causing friction as well as a jump when the belt runs over the pulley. Belts should be laced with a lace corresponding in size to the size of the belt. Usually a narrow lace gives more satisfaction than a wide one.

Leather lacing is made both tanned and rawhide, the latter lace gaining much in favor among engineers at the present time. The cut leather laces are sold in boxes containing 1 pound, or 100 feet,

For damp places rawhide lacing is found to give the best satisfaction. The rawhide is also used for high temperatures of about 200 degs., though it must be replaced oftener than that used in damp places.

For ordinary temperatures and places, leather lacing cut or spiral is used as well as numerous patent methods, a number of which are shown in this article. Wire lacing is used with good results if laced about three-quarters of an inch from the joint.

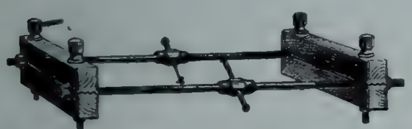


Fig. 2.—Belt Clamps, Dodge Mfg. Co., Toronto.

Lacing a Belt.

In punching a belt for lacing, use an oval punch, the longer diameter of the punch being parallel with the sides of the belt. Punch two rows of holes in each end, placed zigzag. In a 3-inch belt there should be four holes in each end—two in each row. In a 6-inch belt, seven holes—four in the row nearest the end. A 10-inch belt should have nine holes. The edge of the holes should not come nearer than three-quarters of an inch from the sides, nor seven-eighths of an inch from the ends of the belt. The second row should be at least 1¾ inches from the end. On wide belts these distances should be even a little greater.

Begin to lace in the centre of the belt and take care to keep the ends exactly in line, and to lace both sides with equal tightness. The lacing should not be crossed on the side of the belt that runs next the pulley. In taking up belts, observe the same rules as putting on new ones.

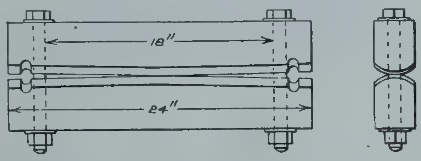


Fig. 3.—Belt Clamps.

Belt Punch.

Fig. 1 shows a simple design of a common leather belt punch, scratch awl and hook, and will be found a very useful little article in repairing or lacing belts. The awl and hook is riveted to an ordinary belt punch, so that it can be turned in any desired position. The hook is for pulling out the laces and the awl for making or enlarging holes when lacing.

Wire Lacing.

Opposite each hole cut a groove the width of two thicknesses of wire and slightly deeper than one thickness. Then lace the belt twice through and be careful not to kink the wires, not to cross them, to lay them parallel in the grove and to pull up tight.

After lacing, hold up on the back outside of belt with a piece of smooth, flat iron and gently hammer the wires down in the grove. Then apply a thick belt dressing freely to the joint. This belt dressing seems to protect the wires from friction and to lubricate a little. Belts so laced will run years without attention and the joint is good, flat and smooth. If the wire is nicked by the pliers or hammer, or in any way, it will surely break in a short time.

Belt Clamps.

Large belts are usually spliced and a frame is used in making the splice. Fig. 2 shows an iron screw belt clamp with corrugated and bevelled jaws, which tightly grip the belt.

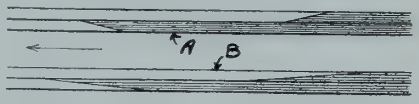


Fig. 4.—A is Splice for Low Speed Belt and B is for High Speed Tight Belt.

Fig. 3 shows another belt clamp, which is made of hardwood, maple being the best. It should have a thin piece of leather glued to the part that fits or grips the belt so as to prevent slipping. The side rods are made of ¾-in. iron with right and left-hand threads and hexagon in centre for a wrench. Always open a belt in the worst place when a splice is to be made, as the splicing strengthens it.

Making a Splice.

Fig. 4 shows the dove-tail splice for double-ply belts. A shows the splice for light, low-speed belts, while B shows a splice for high-speed tight belts. The arrow shows the direction in which the belt is to run.

Fig. 5 shows the tools used in making a splice; a is a scraper 4 inches square, with a wooden handle; b shows one style of "heeler" for paring down the belt for splicing. The belt after paring is scraped by the scraper a. A writer in Southern Machinery gives the next procedure. Place the belt in the most convenient position and put the clamps on. Put the first-end clamp on first, as this is always the easiest point to clean and fit. After deciding on how much is to be taken out measure off this amount on the belt and place the clamp at a point

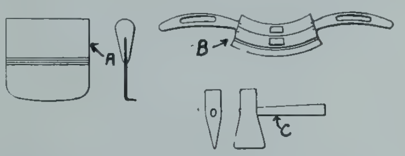


Fig. 5.—Splicing Tools.

8 or 10 inches from the end of the splice. All of the shortening must be done on the first-end on account of the ease with which the new lap can be made. If the second-end is scarfed first there would be two outside ends to scarf, whereas if we shorten the first end we have but one end to scarf and it is on the inside of the lap. The first clamp, with the centre mark on the clamp coinciding with the centre of the belt, should be very tight, for should it slip when the load is put on it will slip in the middle of the belt and may not slip on the edges at all. Should it be glued in this condition the chances are in favor of the outside edges giving way.

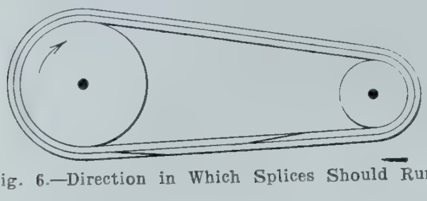
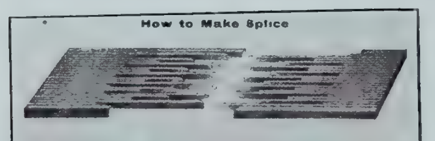


Fig. 6.—Direction in Which Splices Should Run.

After the first clamp is in position and tightened, put on the second one, leaving the bolts loose, so that it can be moved easily. Then put the belt rods in position and tighten the clamp. Tighten the rods enough to take most all the load. Then open the joint. The place to start is top, b—Fig. 4. This inclined point is about 4 inches long and must be opened at both ends of the splice before the middle is touched. After opening both ends for 3 or 4 inches take the hammer and finish by light chopping. When the belt is entirely apart, tighten up on the rods until the belt has the proper tension. Put the splicing boards under the joint, throw the two ends of the belt back over the clamp. Put the two ends back on the boards and lay off the laps. Take a square and get the two thin points square. Put the first-end in between them. The first-end point will have to be cut off before the belt will lie down properly, and the amount to cut off will be equal to the distance between the clamps.



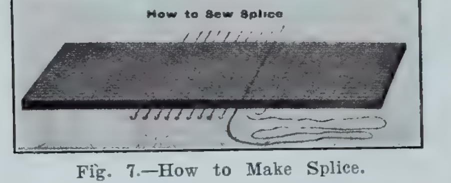


Fig. 7.—How to Make Splice.
Fig. 8.—How to Sew Splice.

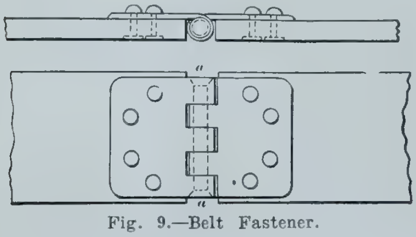


Fig. 9.—Belt Fastener.

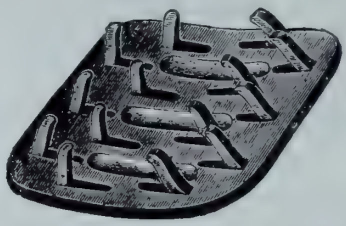


Fig. 10.—Ashton Belt Fastener.

After the point has been cut to the proper length, take a square and make a mark across the belt, using the end of the thin point as the measure for length, and, without moving the belt, make a mark on the edge showing just where the lower thin point came on the bottom. Put the last-end over the left-hand clamp out of the way and scarf down the top of the first-end point, letting the scarf be about 4 inches long on an 18-inch belt. Be careful not to gouge a hole in the belt, and make the incline plane smooth and straight.

When the 4-inch scarf is finished clean the glue off of the inside of the first-end lap to the point where it enters the last-end. Turn it over and place a scarfing board under it and make the other scarf. Clean all the glue off the last-end lap and bring it down to the proper thickness with peelers and scrapers to a knife edge. When the thin points are properly finished lay the whole splice back on the splicing board just as it will be when glued, and do any fitting that may be necessary, being careful to get it thin enough so as to avoid a hammering noise when going over the pulleys. Do not try to glue more than 6 inches at one time. Use a heavy paint brush 2 inches in diameter and have the glue well cooked. Keep the brush in the pot all the time it is cooking. When taking the brush out of the pot, work fast to get all the glue off the brush possible, then get the rest on the belt at once. Make two or three quick strokes across the belt and close down the splice, rubbing with the handle of scraper for about two minutes. After glueing and rubbing down properly, allow to stand from four to six hours.

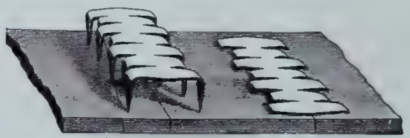


Fig. 11.—Belt Fastener of Bristol Co., Waterterbury, Conn.

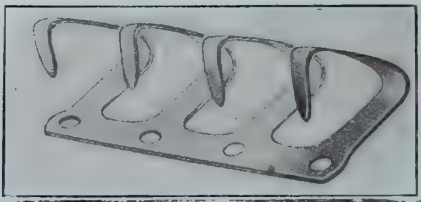


Fig. 12.—Belt Fastener, Black Diamond Mfg. Co., Cincinnati.

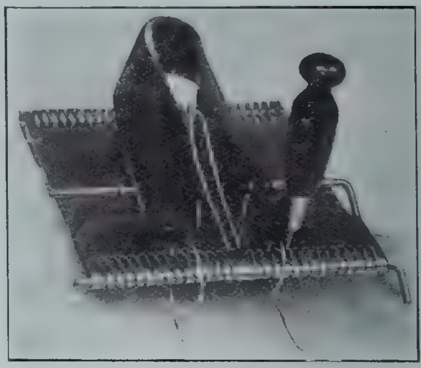


Fig. 13.—Inexpensive Outfit for Wire Belt Lacing.

Splicing Laminated Belt.

Fig. 7 shows Hendry's laminated leather belting ready for splicing. To make a splice, bring the ends together, insert a pin through the outside edges about the centre, then place each alternate strand on the pin. The remainder of the pins will then go through easily.

After the pins have all the strands in place, take the special needle and thread for the purpose and sew, as shown in Fig. 8. Tie a knot at the end of the thread in starting and also when finishing.

Belt Fastener.

Fig. 9 shows a belt fastener. It is made of a common T-hinge of the proper width, which is secured to the belt by eight 3-16-inch copper rivets. The pin-hole should be countersunk in the ends as at a, and the edges of the hinge nicely rounded. A brass pin should be inserted in place of the steel one and

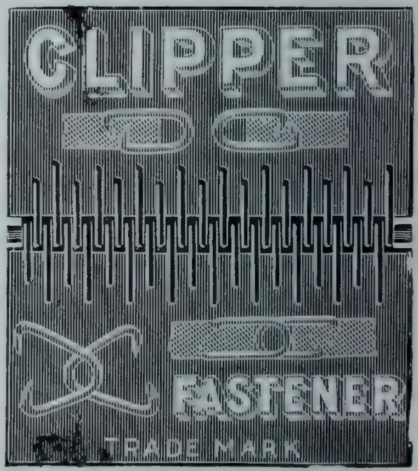


Fig. 14.—Clipper Belt Fasteners.

riveted over on the ends. The knuckle part of the hinge comes between the ends of the belt. On wide belts, two or three hinges may be used.

Steel Belt Fasteners.

A British belt fastener was recently placed on the market, made from stampings of sheet metal. The teeth of this fastener are pressed out of the plate itself, Fig. 10, and their curved shape joins the belt securely.

Fig. 11 shows the Bristol steel belt lacing. In the illustration they are shown ready to apply and the finished joint is illustrated. The steel belt lacing is made in several widths to suit belts..

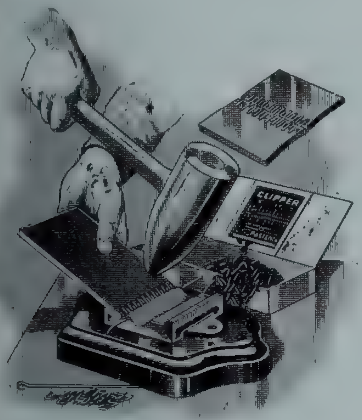


Fig. 15.—Clipper Belt Lacing Machine.

Fig. 12 shows the Black Diamond belt fastener. These are made so that a No. 2 will lace a belt two inches wide, or three No. 2 will lace a belt six inches wide. Five No. 4 will lace a belt twenty inches wide, etc. When the fasteners are in place the ends of the belt may be separated by pulling out the key.

Wire Belt Lacing.

The Mumford Mfg. Co., 258 West 22nd Street, New York, have a wire hinge belt lacing device on the market, shown in Fig. 13. The templet is fastened to a bench. As shown, it is done by staples which project through slots in the plate, and it is locked by a wire rod passing through the staples . The end of the belt is inserted in the turned-up front of the templet, where it is held by lightly driving in one or two wire nails, as shown. The slots serve to guide the workman in making the holes with the awl, and in threading the wire through them with a pair of pliers. The wire lacing is threaded over a mandrel placed in the templet in front of the belt, as shown.

The slots run right-hand on one side of the centre and left-hand on the other. For narrow belts, such as that shown in the engraving, the belt may be doubled back so that both ends are laced at once, one of them right-hand and the other left, allowing the laced ends to interlock properly. Wide belts should be placed in the templet evenly spaced on each side of the centre line, so that half of the lacing is right-hand and the other left-hand. When the other end is placed in the similarly laced templet the other side up the two ends will interlock.

The templet at one end provides for single-thickness belts and for double-thickness at the other. The slots for the latter are alternately long and short, allowing for staggered lacing. While the device has a width of only 6 inches, it may be used on any width of belt by shifting from one position to another.

Clipper Fastener.

The Clipper belt lacer is shown in Figs. 14 and 15. It is made of special wire, the method of making the joint being shown in Fig. 15. There are a great many of these used in Canada in planing mills and machine shops for belts up to 10 inches in width. The Clipper belt lacer was placed on the Canadian market by the General Supply Co., Ottawa.

Chain Joint.

The chain shown in Fig. 16 is the Renold, handled by Jones & Glassco, Montreal. It illustrates the simple manner in which chains, which are applied in many cases for the transmission machinery, are joined.

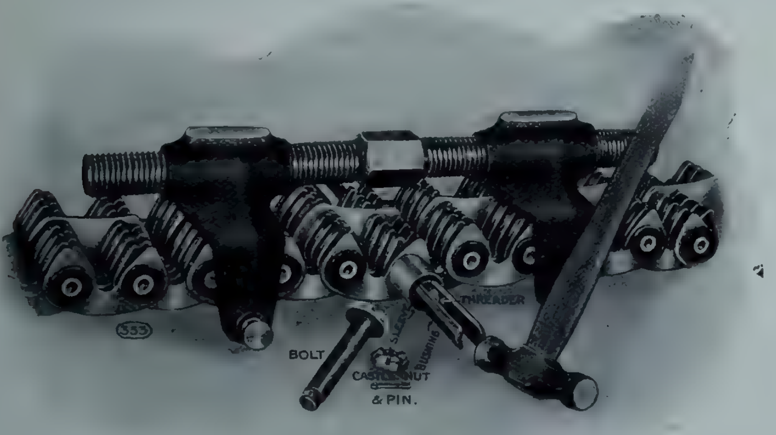
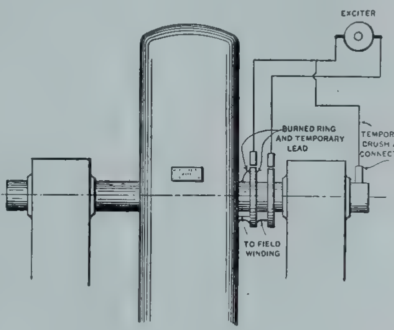


Fig. 16.—Making a Joint on Renold Chain.

REPAIR JOB ON AN ALTERNATOR.

By D. A. Hampton.

The burning of a collector ring on three-phase rotary field alternator supplying current to individual motors, forced a tie-up in a factory putting out a food product which was highly perishable. Owing to the nature of the output and the inability of the engineer to temporarily repair the alternator until a new ring codld be cast, or one secured from the makers, a highly developed case of uneasiness attacked the management that was not relieved until a smart machinist made a suggestion, which he was allowed to carry out. His scheme, as simple as it was successful, is shown by the accompanying engraving.


EXCITER
BURNED RING AND TEMPORARY LEAD
TEMPORARY BRUSH AND CONNECTION
TO FIELD WINDING

Temporary Repair on Alternator.

The brush was first removed from contact with the burned ring. Then by setting the brush in a temporary holder, so that it was in contact with the shaft to which a lead from the burned ring had been soldered, the exciter circuit was closed. This completed the job, and in less than two hours the machine was again running, which it continued to do until the arrival of a new ring from the factory. So, what at first seemed to be a serious breakdown and loss, resulted simply in a slight delay.—Machinery.

On May first the Dearborn Drug and Chemical Works will move their general offices and chemical labratories from the Postal Telegraph Building, where they have beeen located since the organization of the company, more than twenty years ago, to the new McCormick Building, on Michigan avenue and Van Buren street. The extensive growth of the business of the company has made necessary this removal to its new home, where the general offices and labratories will occupy the greater portion of the top floor of one of the finest office buildings in Chicago. The Dearborn Company will have the entire frontage on Michigan avenue for its offices and laboratories, with a total floor space of more than five thousand square feet.

British Practice in the Distribution of Power

The Snowdon Instalation of North Wales Power and Traction Co. has Some Interesting Features in the Generation and Transmission of Power.

The Snowdon hydro-electric plant of the North Wales Power and Traction Co. is situated in Wales on the eastern slope of Snowdon, the 1,140 ft. drop from lakes Glaslyn and Llyn Llydaw, is utilized in carrying out the scheme. The power is then transmitted across the hills to the slate quarries for which North Wales is famous. The whole work was carried out by Bruce Peebles & Co., London and Edinburgh.

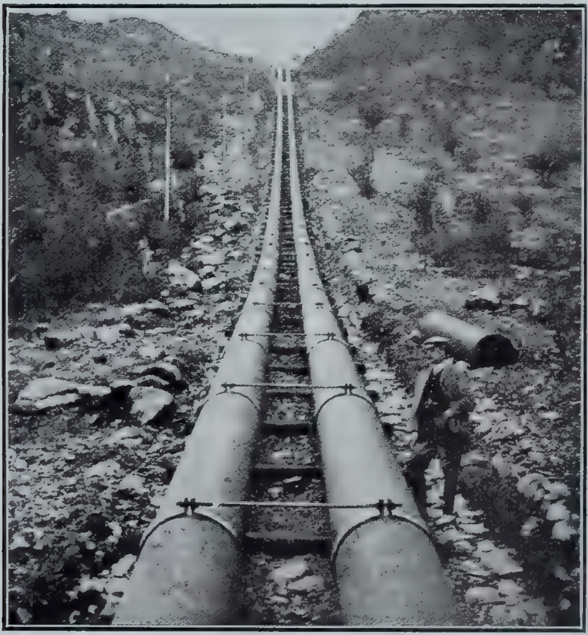


Fig. 1.—Upper Section Pipe Line.

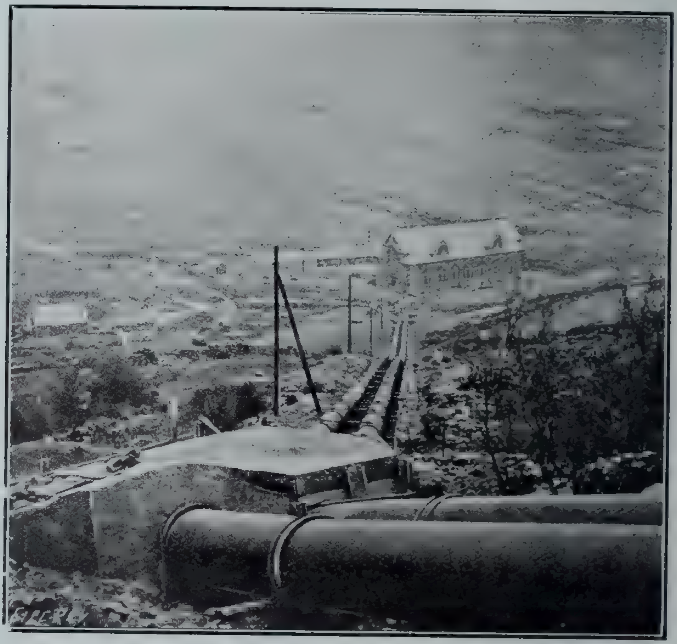


Fig. 2.—Pipe Line and Anchorage; Power Station Below.

The duplicate pipe line is shown in Fig. 1. The inlet to tunnel, 30 ft. below the lake's surface, is controlled by two 48. in. sluice valves, worked from a gantry above, and accessible through a vertical shaft built in concrete. The fact that the pipe line is only 1¼ miles long, and gives an effective head at the power station of 1,140 ft. indicates its abrupt descent; the section immediately above the power house runs at an angle of 45 degrees to the vertical.

Fig. 1 shows an upper section of pipe line. Fig. 2 shows the pipe line and anchorage, and the power house below. The anchors contain 150 tons of concrete where bends occur in the pipe line.

Pelton Water Wheels.

There are four 1,500 h.p. Pelton wheels, cooupled direct to three-phase Bruce Peebles alternators. Each hydraulic unit is fed through a 12-inch branch pipe, which, entering the building from the pipe race outside, passes through a starting valve and into the wheel case, where it connects to two needle regulating nozzles feeding the wheels. The water pressure, due to its 1,140 ft. head is practically 500 lbs. per sq. in. at the nozzles.

The Pelton wheels are shown in the foreground of Fig. 3. They are of normal design with cast-steel buckets bolted to the periphery of a turned steel disc. A hydraulic governor is attached to each unit which regulates the speed by deflecting the nozzles to some extent off the buckets. The normal speed of the wheels is 500 r.p.m.

Alternators.

The alternators are of the Peebles revolving field type, each with 12 poles

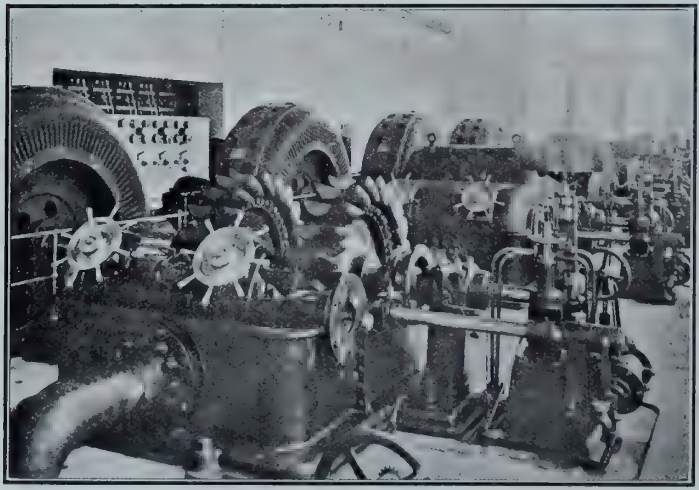


Fig. 3.—Pelton Wheels and Peebles Alternators in Station.

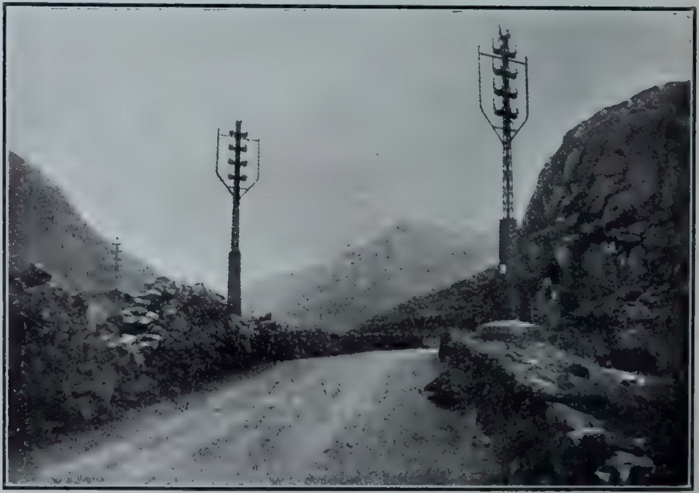


Fig. 5.—Transmission Line Protected by Cradle, Llanberis Pass.

and a rated output of 1,500 k.v.a. at a pressure of 10,000 volts and 50 cycles. A small 45-volt exciter is mounted on an extension of each alternator shaft.

The switch equipment was supplied by Messrs. Ferranti. The switchboards are equipped with the necessary instruments of the most modern hydro-electric plant.

Transmission Line.

The overhead transmission lines, start from a terminal frame outside the switch room; the outgoing feeders passing down inclined ports in the wall, where they are supported in porcelain leading-in insulators fixed in paraffined-board partitions, as shown in Fig. 4, and over insulators to the lines.

Altogether 26 miles of transmissions have been erected for the North Wales Co. One three-phase line, consisting of three 8 mm. wires, makes a bee-line over the mountains in an easterly direction to a point near Roman Bridge, where it turns to the south, terminating at the Oakeley Quarries, Blaenau Ffestiniog, a distance of 7 miles. The principal transmission, however, consisting of three three-phase lines, each consisting of 9 mm. wires, turns north from the power station, subsequently passing in a westerly direction over the Llanberis Pass to a point near the Llanberis railway station, where a 6 mm. line branches off to the right, to Messrs. Asheton Smith's Dinorwic Quarries. The main transmission here turns to the south, climbing over the shoulder of Snowdon, some 2,300 ft. above the sea level, and dropping on the other side of Quellyn Lake, where it crosses the North Wales narrow gauge railway, a line which, with its extensions, will eventually be supplied with electrical power for operating purposes. From this point the transmission line turns westward, terminating at the Pen-yr-Orsedd Quarries, at Nantlle.

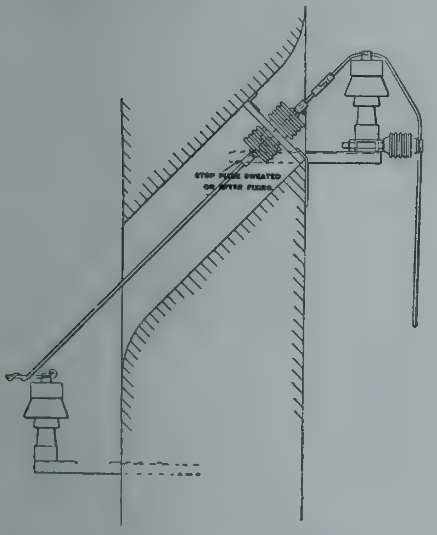


Fig. 4.—Method of Leading Out Feeders From Switch Room.

Protection Over Roads.

Fig. 5 shows the lattice pole construction in the Llanberis Pass, the road span there, and in similar positions, being protected by wire cradles underneath. The latter consist of 5 mm. galvanized steel wires strung between angle iron frames attached to the poles at either end of the span, and laced by cross wires of 3 mm. diameter, the arrangement being shown in the illustration.

Fig. 6 shows the high tension switch gear in the sub-station at Oakeley. Note how the apparatus is protected by wire screens. The power is metered on the low tension side. The low tension distribution is partly overhead and part by insulated rubber cable.

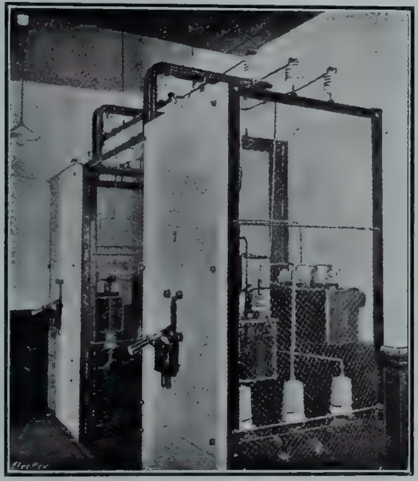


Fig. 6.—Protected Switchgear at Oakeley.

Typical Motor Applications.

The mills are throughout operated by squirrel-cage motors with a speed of 600 r.p.m., and bolted on the wooden tie-beams of the roof; the group system of driving is adopted, through back gear, belting and shafting. The motor leads are bare cables run on bobbin insulators along the roof beams to the end of the building, where the motor-control apparatus is fixed. The latter consists of an iron-clad fitting containing the main-switch, three Mordey enclosed type fuses, and an ammeter, also an auto-transformer below, fixed to the wall.

Of the underground pumping plant, a good example is a two-stage Worthington centrifugal pump, with a capacity of 800 gals. per min., against 220 ft. head. This is direct coupled to a 150-h.p. Bruce Peebles B.S.-type motor with a speed of 1,500 r.p.m., the motor, including the slip-rings, being totally enclosed. The operating switchgear is bracketed to the adjacent rock walls. Fig. 7 shows the above pump.

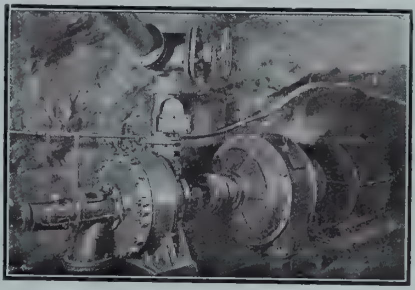
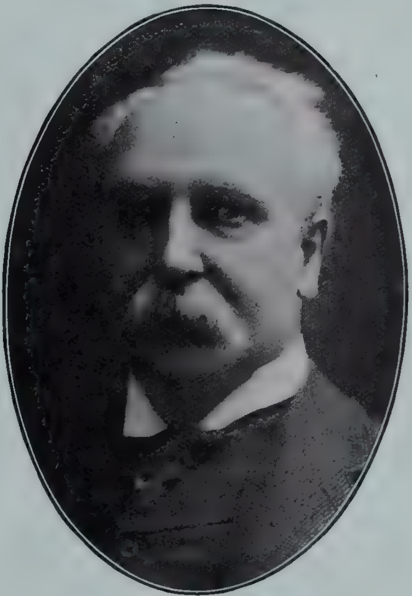


Fig. 7.—Turbine Pump With 150 h.p. Peebles Motor.

GEORGE W. SADLER.

For thirty years G. W. Sadler has been known to the engineers and manufacturers of Canada. About forty-five years ago Mr. Sadler left his native city, Montreal, for Boston, where he learned the trade of belt making. In 1877 he took the agency for L. J. Campbell & Co., an old belting company in Montreal.



GEO. W. SADLER.
Sadler & Haworth, Montreal and Toronto.

In 1884 a branch house was opened in Toronto, and in 1895 Mr. Haworth took charge of the Toronto branch.

The firm has steadily grown until today, they have a sales force of some twenty-five men, and branch houses at St. John, N.B., Toronto, Winnipeg and Vancouver. Their factory is in Montreal, and their tannery at Stonbridge, Que., which has a capacity of 400 hides a week.

Types of Water Wheels for Utilizing Water Power

Current, Undershot and Overshot Water Wheels, and Outward-flow, Inward-flow and Downward-flow Turbines, Showing Special Features of Each.

The waterwheel is one of the earliest devices for the development of power. The improved types are features of the hydro-electric plants of to-day, Niagara Falls being an example of present day practice in the development of electrical energy for transmission. Waterwheels are also direct-connected to pumps to furnish the water supply for cities, towns, etc., and for the generation of power for flour mills, saw mills, woolen mills, etc.

Early Types.

One of the earliest and cheapest types and at the same time the least efficient is the current waterwheel. The blades extend into the water and the power developed depends on the area of the blades and the velocity of the stream. The horse power developed is

$$\frac{A}{150} \times (V\text{-}S)^2$$

Where A=area of blades immersed in sq. ft., V=velocity of stream in ft. per sec. and S=velocity of periphery of wheel in ft. per. sec.

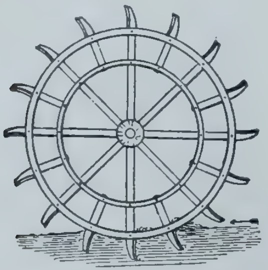


Fig. 1.—Current Wheel.

Another wheel is the "undershot." By it a small water head of from 1 to 4 ft may be cheaply turned into power. In choosing the diameter, the flood nature of the stream should be taken into account. For a flood rise of 3 to 4 ft. a wheel of 8 to 10 ft. diam. may be used. If the flood is 6 to 10 ft. a wheel of 15 to 20 ft. diam. is necessary. The width depends on the power required but should not be wider than the diameter.

As the power realized depends on the velocity of the stream and this depends on the head, the velocity of the stream is $\sqrt{2gh}$ where g is gravity and h is the height of water.

A development of the undershot wheel is the Poncelot, which may be made in the same sizes and construction as the undershot wheel except that the buckets or blades are curved.

The overshot wheel is useful where their is a greater height of water than in the case of the undershot or current wheel and a small quantity of water flow, but is not equal to modern water turbines in efficiency, nor can it use such high heads as may be used with the modern turbine. The efficiency is about 70 per cent. of the value of the water flow.

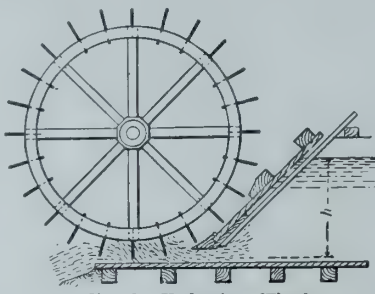


Fig. 2.—Undershot Wheel.

The power of the overshot wheel is derived principally from the weight of water flowing into and held by the buckets. The velocity of the stream from the gate by its low head should only be a little more than the velocity of the wheel periphery, which for the best effect should be about 5 ft. per sec. The bucket should be so proportioned as to hold more than the required volume of water that is intended to be utilized at the best speed of the periphery.

The power generated by an overshot wheel is computed as follows: h.p.=.7 (vol. of water passing gate in lbs. per sec.×height from centre of gate to bottom of spill)÷550. The volume of flow from the gate may be obtained by the formula for the current wheel.

Fig. 5 shows a Pelton wheel. In this wheel the bucket divides the water from the jet. The exit from the buckets is at a slight angle to clear the following buckets. A number of water wheels on the market to-day are forms of Pelton wheels.

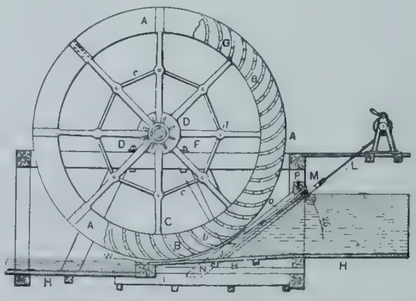


Fig. 3.—Poncelot Wheel.

Turbine Water Wheels.

A turbine wheel is one in which the water enters around the entire circumference instead of upon one portion, so that all moving vanes are simultaneously acted upon by the dynamic pressure of the water as it changes its direction and velocity, The turbine was invented in 1827, and owing to its compactness, cheapness and high efficiency, many have been installed.

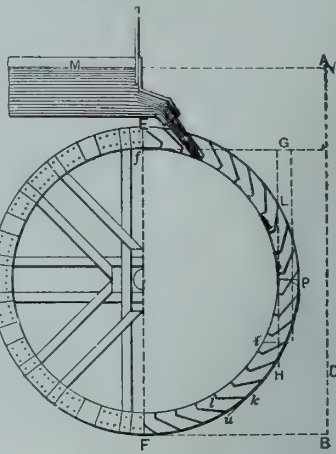


Fig. 4.—Overshot Wheel.

Turbines are usually horizontal wheels, and are outward-flow, inward-flow or downward-flow, according to the manner in which the water flows through them.

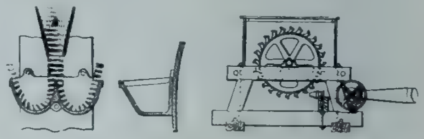


Fig. 5.—Pelton Wheel and Jet Divided Bucket.

In the outward-flow type the water enters the wheel around the entire inner circumference and passes out around the entire outer circumference.

In the inward-flow wheel the direction is exactly the opposite of the outward-flow wheel. In the downward-flow type, the water enters around the entire upper annular openings, passes down between the moving vanes and leaves through the lower annulus.

These three types of water turbines are often called after their inventors, the outward-flow being the Fourneyron, the inward-flow the Francis, and the downward-flow the Jonval turbine.

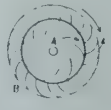


Fig. 6.

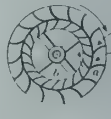


Fig. 7.

Fig. 6.—Outward Flow Turbine, A the runner, B the Fixed Blades.
Fig. 7.—Inward Flow Turbine, A the Fixed Blades, B the runner.

There are a great many turbines on the market, made up of a combination of inward and downward motion, the water entering horizontally and inward, and leaving vertically, the vanes being warped surfaces.

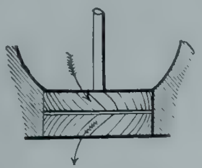


Fig. 8.—Jonval, Upper Blade Fixed, Lower Blades Runner.

Turbine waterwheels allow the economical use of any pressure head from 2 to 50 feet for ordinary wheels and up to 200 feet in specially constructed wheels such as those in use at Niagara Falls.

WATER POWERS OF NORTHERN ONTARIO.*

By L. V. Rorke.**

In attempting to get together some information and results with reference to the water powers on the rivers of Northern Ontario, which empty into James and Hudson Bay, a certain amount of latitude must be granted, because of the lack of accurate information with respect to the different data, which necessarily enter into a fine computation of any water power development. Having traveled over some of these rivers from their head water to the outlet, and taken some cursory notes, the writer feels that the impression gained and the results herewith obtained from a summary of these water powers may be of interest to most of you in this progressive age of hydro-electric development.

Looking over the map of Northern Ontario, you will notice that the rivers north of the watershed to James Bay assume a tentacular aspect with delicate feelers reaching out from the main body of water (Hudson's Bay) to taste of the large bodies of fresh water, which form the head water lakes, visit the ground and you find them great feeders, raging torrents in high water, with no sense of delicacy towards their surroundings. The rivers are in many respects similar, in the lower reaches they become wide, shallow and swift, after tumbling down over what has been termed the Archean Boundary by geologists where an altitude of approximately 250 feet in a distance from 5 to 15 miles, is overcome by a series of falls and rapids. The principal on each river at this Archean Boundary are as follows: On the Missinabi, at the end of Long Portage at what is known as "Hells Gate" a fall and rapid of 140 feet, on the Apazatika, at Break-neck Falls, a drop of 60 feet. On the Mattagami, at the Long Portage falls and rapids, of 150 feet. On the Abitibi, the long rapids between the mouth of the Little Abitibi River and New Post and on the French River tributary Nettogami at Kawash Falls, 110 feet. Above this Archean Boundary there is less current in the rivers, and the basin is coursed by a succession of falls, chutes and rapids with intervening stretches of river, whose velocity varies from 1-3 to 2 miles per hour. The large lakes at or near the head waters are fairly uniform in altitude, being approximately 1,000 feet above sea level and may be enumerated as follows:—The Abitibi Lakes on the Abitibi River, the Frederick House and Night Hawk Lakes on the Frederick House River, the Mattagami and Kenogamisee Lakes on the Mattagama River, Pish-kan-og-am-a, Matagaming and Rice Lakes on the Ground Hog River, the Missinabi, Kapuskasing, Opozatika, Kabanikagami, Kenogami and Ogoke Lakes at or near the heads of the respective rivers of the same name, Rainy Lake, Lake of the Woods and Lac Suel, at the head waters of the Winnipeg River and its tributary the English River.

The drainage basin of these several rivers within the limits of the Province of Ontario is approximately 100,000 square miles. The altitude of the head waters and length of rivers being approximately the same, and the river beds having a fair degree of uniformity. I propose to make certain deductions and arrive at some conclusions as to the amount of water power in the larger falls on these respective streams.

Every water power estimate must be calculated to be accurate on its own merits taking into consideration the annual water flow and its superficial surrounding, the natural head varies with the flow, and the flow varies with the temperature and rain fall, from month to month; in fact the only constant is the drainage basin, which remains always the same; unless the water is diverted by artificial means from its natural course, or by earthquakes; of which we know little by experience in this country.

In drainage area calculations, the amount of run off as compared with the total rain and snow fall must be known. This percentage will vary with the conditions of the atmosphere, the quality and chemical composition of the soil and the grades of the valleys, hills and plains, which comprise the entire drainage basin. From information to hand in this respect a fair and conservative deduction of the volume of flow in these rivers can be arrived at by assuming a constant number of cubic feet per second discharge, to each square mile of area drained. The drainage area and head waters of the Ottawa River adjoin some of those herein enumerated, and the volume of water in this river has been carefully gauged and investigated in connection with the Georgian Bay Canal scheme, with the following results:

The average annual precipitation for 10 years preceding 1906, was 31.72 inches and the average discharge 53 per cent. of the precipitation or 16.8 inches.

The drainage area is 56,000 sq. miles and for the same 10 years the average yearly mean discharge was 56,641 cubic ft. per sec., the maximum high water discharge 3 times the mean discharge, and the minimum low water discharge 65-100 of the mean discharge. The results obtained from this discharge area are that mean discharge is 1 c.f.s. per sq. mile area and the minimum low discharge is .65 c.f.s. per sq. mile area.

The Spanish River has been estimated to have a minimum discharge of 1,800 c.f.s. and 3,500 sq. miles area=.51 per sq. mile.

	c.f.s.		Sq. miles area
Mississagua River	1,050	and	3,500=.30
Sturgeon River ..	900	"	2,000=.45
English River ..	8,000	"	20,000=.40
Winnipeg River	20,000	"	50,000=.40
Montreal River ..	750	"	1,500=.50
Trent River	1,600	"	4,000=.40

The average minimum low discharge of these rivers is .45 c.f.s. per square mile and for the purpose of this paper it will be well within the limits to assume 4-10 c.f.s. per square mile.

On the western part of the slope, the total precipitation is less than in the Ottawa River basin, but the percentage of run-off is greater. The average yearly precipitation during 10 years preceding 1907 in the Winnipeg River basin has been 23 inches and the run-off 70 per cent. of the precipitation of 16.1 inches, practically the same as the Ottawa River Basin.

In these rivers of our northern slope, the high water run-off is more gradual than on the southern slope. In such rivers as the Nepigon, Magpie, Pigeon, Spanish, French and others emptying at the north shores of Lakes Superior and Huron, the spring freshets are heavier and of shorter duration, because of the large amount of rock-exposed territory and the more broken and steep hills therein. The maximum discharge is not reached on the northern slope until late in the month of May or early in June, and owing to the gentler slopes of the land and the forest-covered area, the run-off is more gradual. Taking this into consideration the annual discharge can be more easily and uniformly controlled and requires less storage than such rivers as mentioned above.

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* Abstract of address read before Toronto Engineers' Club.

** Inspector of Surveys for Ontario.

On the Abitibi River, for example, we have a storage basin of 460 sq. miles in the Abitibi, Night Hawk and Frederick House Lakes; with a rise of 10 feet above low water mark (one square mile 1 foot deep = .88 c.f.s.) a storage of 4,000 c.f.s. could be obtained to maintain a mean discharge during the low water months, this is quite sufficient after allowing a reasonable percentage for evaporation.

A cross section of the Abitibi River, near the National Transcontinental Railway crossing, gives an area of 5,000 square feet below normal water level and 10,000 square feet in mean high water. The water from an area of 6,500 sq. miles discharges through this sectional area, in low water at the rate of 1-3 of a mile per hour, in high water at the rate of 1½ miles per hour, a calculation based on the principle that the low flow is .4 c.f.s. per square mile and the mean high water 3 c.f.s. per square mile.

From this cross sectional point which is 800 feet above sea level, after deducting 280 feet in the falls and rapids, which are noted and 200 feet for the lower reach of the river where a uniform fall of probably 2 feet per mile exists, there remains a fall of 320 feet in a distance of 200 miles, or about 1 6-10 feet to the mile. This of course includes many minor rapids, which when estimated, would reduce the uniform river velocity to probably what is deduced from the above sectional discharge.

It has been ascertained that on the Winnipeg River in the Province of Manitoba, an aggregate head of 247 feet is available for horse power development, with a minimum efficiency of 486,000 h.p. which is equal to ¼ that of the great Canadian falls at Niagara. It may be of provincial interest to state that 75 per cent. of the drainage basin of this grand river, lies within the province, and 95 per cent. of the total discharge passes through the province before reaching the outlet into Lake Winnipeg. With control dams at Lake of the Woods, Rainy Lake, Lac Seul and other large lakes on this river and its tributary the English, the minimum efficiency of all powers on this river both within and without the province could be doubled.

The large water powers in Ontario on this river are enumerated herein, giving the same minimum low water flow per mile, as those on the more eastern end of the slope. The White Dog Falls and Rapids about 15 miles below the N.T.C. railway crossing is the 3rd largest water-power in the province. Niagara being the largest and Sault Ste. Marie Rapids the second largest.

Aggregate of the water power on the larger falls and rapids of the more important rivers on the northern slope:

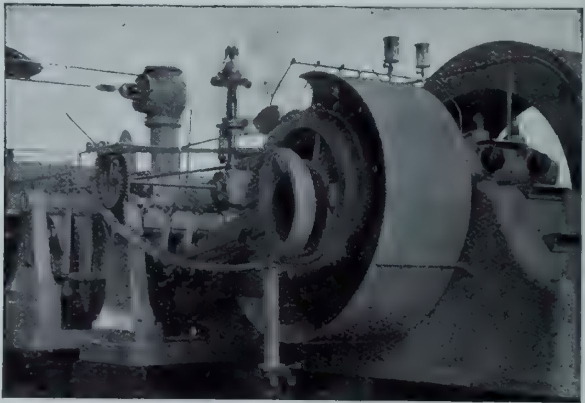
	Total Height in falls. ft.	Possible H.P. Development
Abitibi, Black and Frederick House	451	359,300
Mattagami, Kapuskasing & Ground Hog	830	393,800
Missinabi and Opazatika	534	292,100
Kabinakagami and Kenogami	486	98,800
Ogoke	170	216,600
Winnipeg and English	91	370,000
Totol aggregate		2,030,600

In compiling this aggregate estimate the error is a minus quantity. Many rapids on these large rivers are not noted and many falls on the smaller tributaries such as the French, Little Abitibi, Muskego and Wabigoon rivers, which will develop from 500 to 5,000 h.p. do not figure in this total, neither is the water power on the River Albany—which at the present time forms a portion of the northern boundary of the province and has a drainage basin of about 50,000 square miles—included. The margin will be quite sufficient to balance the loss in converting from theoretical to practical horse power; the loss in transmission of energy to points within reasonable distance, and all other losses which accrue between the water power and its natural state and the manufactured article by means of that power.

CHAIN GOVERNOR DRIVE.

The William Tod Co. has for several years employed machine cut chain and sprocket governor drives. The arrangement of sprockets, shafting and bevel gears by means of which an absolutely positive speed ratio is maintained between main and governor shafts is clearly shown in the illustration.

This particular drive is also interesting as a part of the largest tandem compound engine ever built (52 in. x 90 in. x 60 in.). This engine was made to drive a 43-inch three-high blooming mill in the Youngstown, Ohio, works of the Carnegie Steel Co. It is rated at 4,000 h.p., but delivers a peak load of 15,000 h.p., which is accomplished by means of a 24-foot fly-wheel, weighing 120 tons. The engine is, of course, dependent upon the governor for successful operation and the duty of the governor drive in steel mill work is unusually severe, owing to the sudden variation of load. Chain has proven to insure close governing. In the illustration, the outboard bearing, fly-wheel, main shaft, driving sprockets and the chains are removed to show the governing mechanism better. The position of the chains in service is indicated by that of the chain guard. It will be noticed from the double driven sprocket and the width of the chain guard that two chains are used.



Chain Governor Drive.

These are of the standard roller type similar to the one used in automobile service, and are made by the Diamond Chain & Manufacturing Co., Indianapolis, Ind. A single chain transmits sufficient power to drive the governor shaft, but the second chain is added so that one chain will always be working in case of an accident to the other. The chains, however, have never given trouble from any cause, and they require no attention, save an occasional oiling.

PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

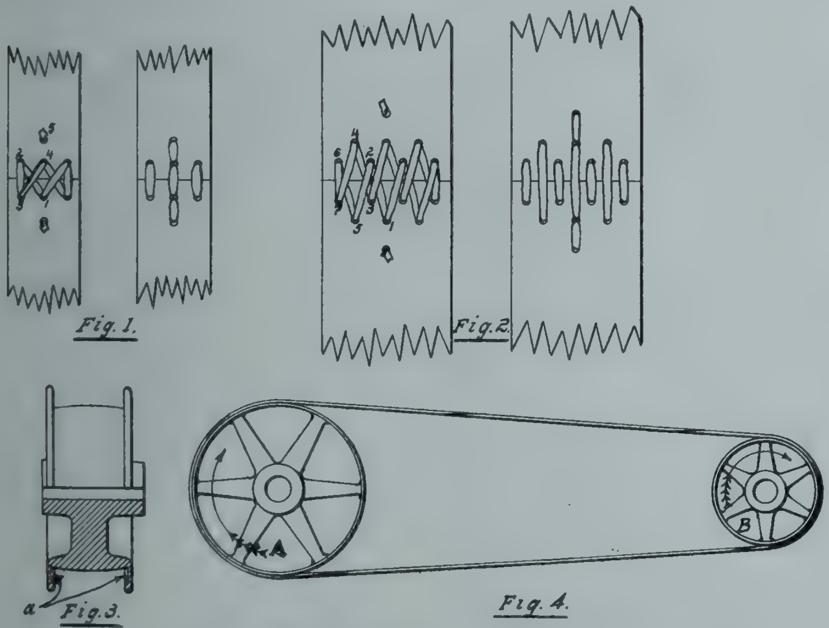
CARE OF BELTS.

By J. H., Hamilton.

Leather belts being one of the greatest mediums for the transmission of power. The care and service of the belt and accessories should be one of the chief duties of the engineer, or man in charge.

Leather belts should always be run with the hair or grain-side next the pulley, as the strongest part of the belt is near the flesh side; the hair side being more brittle than the flesh side, the compression will come upon the inside of the belt when passing over the pulley. Wherever possible the driving portion of the belt should come upon the lower side, as the slack of the belt, caused by the extra tension of the drive will come on the upper portion of the belt, thereby giving more surface contact on the pulleys.

Where flanges are used to guide a belt, or in the case of cone pulleys, the face of the flange or cone should be undercut as shown at (a) Fig. 3, and kept clean. If dirt and grease are allowed to gather on the face, the belt will be inclined to climb the flange, and if it succeeds in climbing it usually means a broken belt.



Care of Belts, Showing How to Lace them, etc.

I have noticed on several occasions where a stick was secured to the ceiling to keep a belt from coming off. This is a bad practice, as in time the edge of the belt becomes worn and rough. If a guide is necessary a roller should be placed in position instead of the stick, but a better way would be to remedy the cause of the trouble, which would likely prove to be a defective pulley, poor belt lacing or the shafting out of alignment.

Where belts run at a very high speed, care should be taken to have the pulleys run as true as possible. If the pulleys are not running true, the centre or crown is continually changing its position, and as the belt cannot follow this change fast enough, the belt will oscillate from side to side, especially if the belt is slack.

Belts may be fastened in several ways: By splicing and cementing making an endless belt; by lacing with leather lace and by the use of metal fasteners in many forms; leather lacing is the form most universally used, as it is flexible and runs smoothly over the pulleys.

Fig 1 shows a good way to lace a small belt, where one row of holes are used. First see that the belt is squarely cut so that both edges of the belt will be the same length. Punch the holes so that they are directly opposite each other.

Pass the lace through 1 from the under side then through 2, 3, 2, 3, 4 and 5, make a cut half way through the lace just clear of the hole 5, then about $\frac{1}{4}$'' out cut off the lace. Proceed in the same manner for the other half.

For large belts a double row of holes are used as shown in Fig. 3; the width of belt will determine the number of holes. The order of lacing is through 1, 2, 3, 4, 5, 6, 7, 6, 7, 4, 5, 2, 3, x, y; secure at Y.

The two halves should be laced together as it helps to keep the belt in position.

Where it is necessary to enlarge the holes for the laces, one hole should be punched directly behind the other, not side by side, as the belt will nearly always break accross the lace holes, and as small a punch as possible should be used. Always have the straight part of the lacing on the hair or smooth side of the belt, so that they will come in contact with the pulley surface.

Where a belt has to be shifted from one pulley to another (especially on cone pulleys), metal fasteners should not be used, as it may prove dangerous to the hands of the operator.

When a belt is placed on a pair of pulleys it should be put on as shown in Fig. 4, so that when the splice comes in contact with the pulleys it will help to keep the splice together.

In the majority of cases where slipping takes place it will nearly always be on the smaller pulley (where pulleys are of the same material), and it will be seen that by running the belt as in Fig 4 it will help to preserve the splice.

By covering the pulleys with leather or some material which will give a greater friction, more power can be derived, but the covering should be glued or cemented on.

While repairing a belt some time ago, I noticed that it was nearly cut in two the full length, one of the pulleys had been covered with leather, and secured with tacks and nails; a few of the nails had worked out, and the slipping caused by the irregular strains on the belt had nearly ruined it.

As the pulley was on the main shaft I suppose the man responsible thought the pulley could do its own "driving."

COUNTERSHAFTS AND BELT DRESSINGS.

By L. Bailey.

Countershafts cut quite a figure in transmitting power to various machines and there is any number of clutch counters that are supposed to be far superior to the old tight and loose pulley class, and no doubt they are for slow running machines, but for high speed such as is required for brass working tools there seems to be a want that has not been supplied up to date.

The writer has had considerable experience with countershafts with clutch pulleys on, of several different manufacturers, and I must say that I have not seen one that has been quite satisfactory. The difficulty seems to be that the lubricant throws off with the high speed and the counter being reversed quickly, cuts or grinds away the grip and the adjustment having to be made so often soon becomes exhausted.

There is also another defect, namely, the hub of the pulleys are too short on the side next to the clutch and the bore of the pulley soon wears taper and the belt will run on one side of the pulley so that when the clutch is thrown in, off goes the belt. Of course, a fellow don't mind that especially if the ladder is not handy, or Tom, Dick or Harry got the belt stick and forgot to bring it back. Well, perhaps some of my fellow mechanics have had better success than I, so I would like to hear from some of them on the subject.

A Belt Dressing.

It seems to me that this is something like patent medicines. We think that they are O.K. for a while, then something else comes along and so we keep trying new dressings. I have come to the conclusion that the castor oil treatment is best for the reason that when the so-called belt dressing is applied it is good for a while but soon wears off and another dose is needed.

When castor oil is applied, it goes right through the leather and makes it very pliable and also prevents the belt from slipping on the pulley.

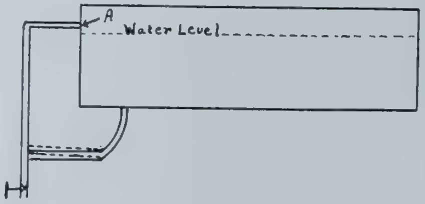
When putting on a new belt it is often difficult to keep it on because of the slick surface and the stiff leather. To get over this difficulty when your belt is cut to length lay it down and give it a coat of castor oil and when you have put it on the pulleys it will stay.

A CLEVER IDEA.

By R. McLaren.

While inspecting some boilers recently, I noticed that the blow-off pipes had connections above the tubes for the purpose of providing circulation in the pipe in order to keep it clean. The idea is a good one, when carried out properly. In this case the upper connection on one boiler was at high water level, so that it was only when the water was high that there was any circulation. The other one was an inch or two lower. Don't you think the man who did that job missed his calling?

Many engeneers take great pains to protect their blow-off pipes from the heat by covering them. An objection to this is that small leaks may cause the eating away of the pipe by corrosion A better way is to provide circulation by the means mentioned above and shown in the sketch. A point to be careful about in connection with the blow-off is to have the pipe incline downwards slightly, away from the boiler, as shown in the full lines in the sketch, and not as shown by the dotted lines.

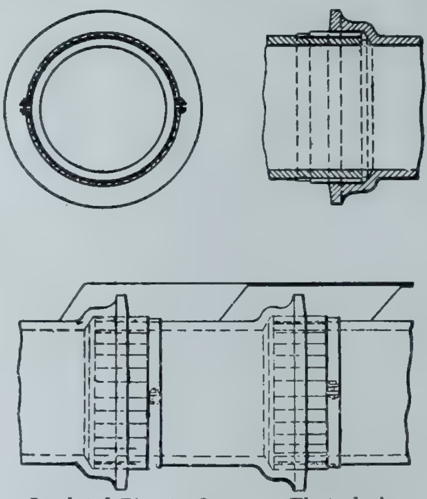


A Clever Idea—A is the Circulating Pipe Connection.

This will allow any steam formed to pass up into the boiler along with the circulation and thus aid it instead of retard it.

ELIMINATING ELECTROLYSIS.

In Winnipeg recently a great amount of money was spent to overcome the electrolysis of waterpipes. Toronto and Hamilton have also been troubled to some extent. To reduce danger from electrolysis of water mains at Hartford, Conn., insulating joints have been introduced in a number of places. The construction of these joints is shown by the accompanying cut. It consists essentially of an ordinary pipe joint with the lead space filled up with wooden wedges and a wooden ring slipped inside of the bell end of pipe to keep the spigot end from "bottoming." If a sleeve is used instead of a bell end the wooden ring prevents the two pipe ends from touching inside the sleeve. A double joint of this kind is used for greater security, the two joints being made up in as small a length as convenient.



Insulated Pipe to Overcome Electrolysis.

The wooden wedges are held in place by clamps around the pipe. This double insulating joint is installed by cutting out a piece of the main of the proper length and putting in the joint in place of it. A load of crushed stone is thrown in to keep moisture away from the joints as much as possible as damp earth around the joint would impair its efficiency. Three wires tapped unto each double joint, as shown, were brought up inside a service pipe box. Tests of these joints showed that they completely stopped the flow of current when first installed; further tests will be made this spring to determine their continued efficiency. The above information is taken from the report of Mr. H. E. Dart, assistant engineer, to the Board of Water Commissioners, Hartford, Conn..

FEEDWATER TEMPERATURE.

By F. Nagle.

I have often thought it strange that steam plants with a feedwater heater do not have in sight a temperature gauge. A few have a thermometer attached but very few. I took charge of a plant in a woolen mill where I had an Armstrong heater. I used to borrow the dyer's thermometer and put it in the overflow pipe. By that way I got the temperature of the feedwater.

Later I was in charge of a plant where a large Moffat heater was installed. We were making some repairs and I asked for and obtained a temperature gauge which I attached to the heater. It was thought such a good idea that a large woolen plant followed the example.

These are the only two plants I know of, that have the heaters equipped with temperature gauges. It is a good thing for an engineer to know just what is the temperature of the feedwater. Usually an engineer guesses at the temperature but he cannot tell exactly for the simple reason he has nothing he can use in obtaining the temperature.

W. R. Reilly, D.L.S., and Harold Dawson, late chief structural draftsman in the Public Works Department of the Saskatchewan Government, have opened offices in Suite 108 Willoughby and Duncan block, under the firm name of Reilly, Dawson & Reilly, for the practice of architecture, surveying and civil engineering. The firm will make a specialty of engineering works for municipalities, such as road construction, water supply and sewerage.

Correspondence

Discussion on Previous Articles
Remuneration for Useful Ideas

THE INJECTOR.

In The Power House for March, G. J. Parry asks the question, "How does the injector and feed pump force the water into the boiler against its own pressure?" In the first case the energy of the jet of water is derived from the condensation of the steam, and it is easily seen that there will be force enough to force the water into the boiler when you consider that each pound of steam condensed gives up (966) nine hundred and sixty-six B.t.u., and each B.t.u. is equivalent to seven hundred and eighty-eight foot pounds which equals for one pound of steam condensing 966×788=761,208 foot pounds. Some of this energy is wasted, some used to force the water into the boiler and the rest is used to heat the water.

With the steam pump, if you have a two inch feed pipe area of 2 inch-pipe=3.1416 sq. in. ×100=314.16 pressure the pump has to work against plus about 25 per cent. friction which will make the total pressure=419 lbs. It is evident that all that is necessary to overcome (if your water plunger on pump is also 2 inches dia.) would be a steam piston of 3 in. dia. The area of a 3 in. circle is 7 in. or a trifle over, so 7 in.×100=700 lbs. where we only have 419 lbs. to work against, or area of 2 in. pipe ×steam pressure, and, not as a good many suppose the entire area exposed to pressure, and the power of a pump necessary to feed boiler is easily found when you know the amounts of water evaporated, and then you can find the area, or volume of water and being careful to allow plenty for leaks and slip and the power can be found from that.

L. S. RHODES.

CHANGE OF CUT-OFF.

On page 48 of March, The Power House, I find a question by "M.C.S." "How can the cut-off be changed from 1-5 to 1-4 on a Corliss engine without an indicator being used?"

Now the one feature that distinguishes a Corliss engine from other types is that the speed of the Corliss engine is kept uniform, under a varying load, by having the point of cut-off continually and automatically changed by the governor. The governor of a Corliss engine is connected by a pair of trip rods to the knock-off cams with the result that a few extra machines thrown in gear will lower the speed of the engine, the governor will lower with the speed and by lowering will change the point of cut-off to a later point in the stroke and the engine will regain its speed.

When machines are thrown off the opposite will occur; the engine will increase in speed, the governor rise and the point of cut-off occur earlier in the stroke. It is therefore, in a Corliss engine impossible either with or without an indicator to change the point of cut-off. The load must be increased and decreased on a Corliss engine to lengthen or shorten the cut-off. There is but one way in which the cut-off point could be changed without interfering with the load and that would be to run on a higher or lower steam pressure. A higher steam pressure would make the cut-off occur earlier and a lower steam pressure would make it later.

One might stand back and size up a Corliss valve gear and say, "now if we lengthen that head end trip rod and shorten that crank end trip rod we'll make the cut-off occur later." Well, try it and see. You'll find that the load on the engine will demand no later cut-off than formerly and the only result will be that the governor will have to rotate in a higher plane in order to effect the cut-off at the old point and in order to put the governors up to that point the engine will run slightly faster.

The point of cut-off can only be altered and fixed permanently on those engines which have a throttling governor. I should say, however, that if two or more Corliss engines were running hitched together to one line shaft, the governors on one might be blocked to affect a set and permanent cut-off on that engine and the other engine or engines would through their free governors regulate the speed of the group. This idea is sometimes worked out on a compound Corliss engine where the cut-off on the low pressure cylinder is fixed and stationary and that on the high pressure cylinder under the control of the governor.

R. MANLY ORR.

PUMP TROUBLE.

A few years ago I was operating a large duplex compound steam Blake pump. As we were testing it, we were running the pump at a fair speed, and then we shut down and took the air chamber off of the suction pipe, and the water ran along and flowed over and kept running for some time. This pump was setting about 8 or 9 feet above the level of the water, and had 1,200 feet of a 12-inch suction pipe, with a foot valve at the river. This happened at the Canadian Portland Cement Works, on Napanee River. There was a boiler inspector there, and he said it was a rare thing to see this happen.

Will some of the brother engineers explain why the water flowed on in this way after stopping the pump and taking the air chamber off. I would have thought that the foot valve would have set to its seat and stopped at once. Hoping this will be clear enough to understand.

W. F., SUBSCRIBER.

HYDRAULIC QUESTION.

What would be the flow of water in gallons per min. from the open end of a pipe two or three feet long, connected at hydrant or main, "any given size pipe and given pressure?" For example, say the pressure at the hydrant is 80 lbs. per sq. in. and a pipe connected to the hydrant is 2 in. diam. and 2 feet long with open end. How much water will flow through this pipe per minute? Please give rule for finding same.—McG.

STEAM PRESSURE QUESTION.

The engine house is 500 ft. from the boiler. Is there any difference in pressure at the engine house and at the boiler?

Is black oil any good to put in a lubricator or on a pump? What is generally used?

Which is the cheapest and will give the best results in heating a plant, to carry 85 lbs. or 40 lbs. pressure?—Geo. Miller.

J. M. Wilson, Toronto, has been appointed city engineer of Moose Jaw, Sask. He was formerly associated with W. H. Oliver & Co., Toronto.

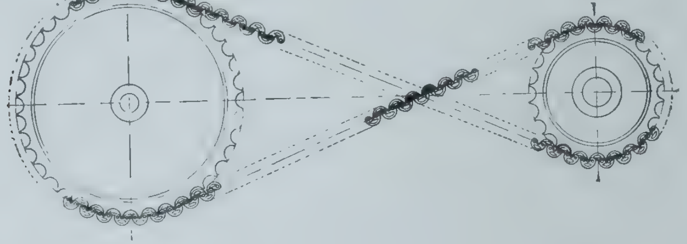
NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must
Have New and Interesting Features — No Write-Ups Can be Used.

REVERSIBLE CHAIN DRIVES.

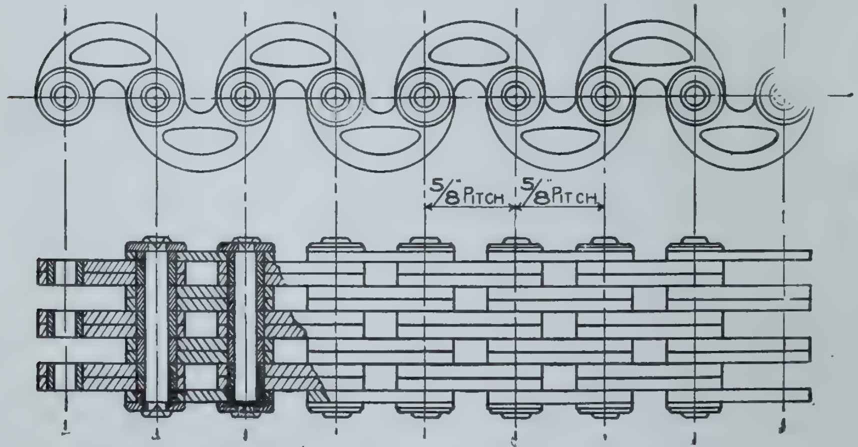
One of the disadvantages; if it may be termed as such, of chain driving happens when it is sometimes necessary to run the chain crossed, so as to give the driven an opposite rotation to the driver. Until recently this has been an impossibility, and the Coventry Chain Co., Coventry, England, have just put on the market a noiseless chain which can be crossed at centres over seven feet.

As shown by the detail cut the chain is perfectly symmetrical and it matters not which side is in contact with the toothed wheel. It will also be noticed that the chain has been lightened considerably by cutting out pieces of every link. This feature of lightness, combined with durability, will no doubt be interesting to the designer of flying machines as also will the fact that it can be crossed and do its work at the high speed of 2,500 revolutions.



Reversible Chain Drive, John Milne & Son, Montreal.

This is a new chain on the Canadian market and is being distributed by John Millen & Son, Limited, Montreal, along with their other lines of Coventry chains.



Construction of Chain for Power Transmission, John Milne & Son, Montreal.

GRAPHITE AS A LUBRICANT.

Graphite has long been known as one of the most, if not the most, suitable lubricant for journal bearings, particularly where the journal is of steel or iron. Inasmuch as graphite is essentially carbon—in fact, pure graphite means pure carbon—this carbon, uniting with the carbon of the shaft by continued contact with it, gradually fills up the small pores or irregularities always present even in the finest grade of machined steel shaft, thus forming a new and practically perfect surface. This new surface hence offers less and less friction as the carbon of the lubricant continues to unite with the carbon of the shaft, and therefore we are brought to the point where it is found essential to keep the carbon (graphite) always present—or better—always distributed along the entire bearing surface.

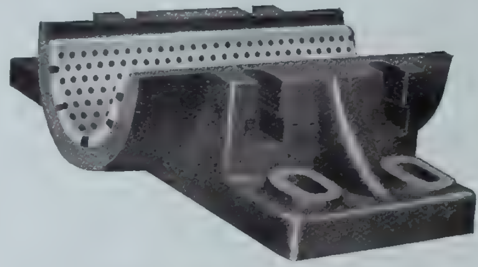


Fig. 1.—Bearing Using Randall's Graphite Sheet Lubricator.

Various means have been suggested for doing this; holes, grooves, and pockets have been made in the bearing surfaces and filled with graphite, but this means has not insured that the graphite would stay there, or that it would be evenly distributed. Practical operations of this class of bearings have demonstrated this fact.

Attempts have been made to unite graphite with grease or oil, and thereby get it to the bearing surfaces by flooding them, or attempting to do so. This also has been partially unsuccessful, in most cases due to the fact that ordinary commercial bearings do not admit of a satisfactory oiling scheme.

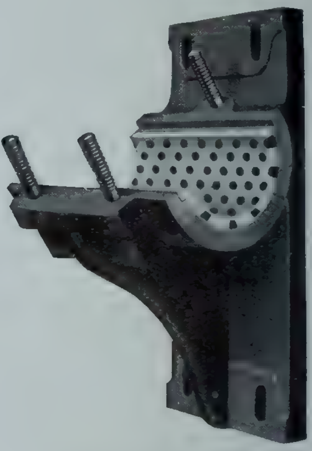


Fig. 2.—Bearing Using Randall's Graphite Sheet Lubricator

The Randall Graphite Sheet Lubricator, as it is called, has been tried out thoroughly by many of the principal railroads of the country; and such reports as an increase in mileage of brasses of from 22,000 without, to 62,000 with the Randall, has come from one of our satisfied customers. This last statement refers to a test on the brasses under a standard railway coach, on long runs, where one side of the trucks had the Randall Graphite Sheet Lubricator, and the other side the same grade of metal without the Lubricator. The figures given were the miles the brasses stood up without undue wear. It might be added the operators did not know of the difference in construction of bearings, and were instructed to oil each alike.

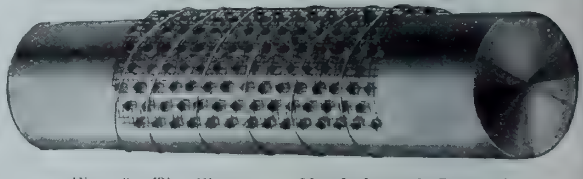


Fig. 3.—Tie Sheet to Mandrel and Pour the Metal in the Regular Way.

Again on the journals of woodworking machinery, for example on a machine running 2,800 r.p.m., best grade of babbitt burnt out regularly every three months. The Graphite Lubricator has been running on this particular machine exactly two years and eleven months, and upon examination, the journals seem to be glazed over, as it were, with the graphite, and by measurement no perceptible wear has taken place.

Randall's invention will stop troubles in lubrication, upon all manner of high-speed automatic engines, dynamos, motors, shafting, car-wheel journals, etc.

The following claims are made for this lubricant: 1. A saving of 75 to 90 per cent. of lubricating oil. 2. Life of bearing prolonged three-fold. 3. Lower priced bearing metal, when used with the Randall, answers as well as more expensive grades. 4. The wire-mesh forms a bond and strengthens the bearing. 5. The metal displaced by the Randall almost equals the cost of this method of graphite lubrication.

To prevent journal heating, large sums are spent anually by the various railroads for lubricating oils, waste and inspection, without entirely removing the difficulty.

Of all the much heralded progress and improvements made by steam and electric railroads, there still remains one of the most important and troublesome parts in which no mechanical change has taken place since the present devices were first used some 40 years ago. Initial cost is low and it is simple to apply.

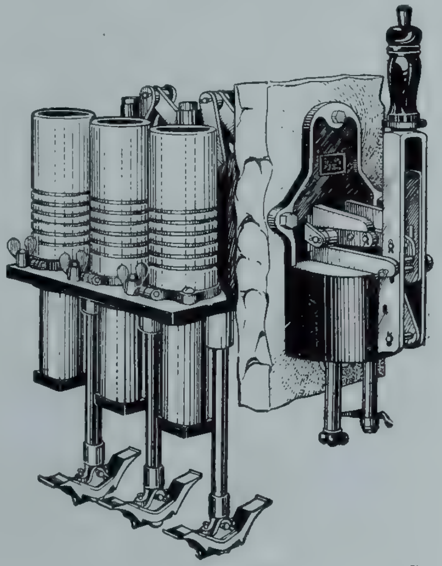
Randall's Graphite Sheet Lubricator is sold by Canadian Fairbanks, 444 St. James St., Montreal.

FUNCTIONS OF CIRCUIT BREAKER.

Every circuit breaker has three functions; first, to properly and without undue heating, carry its normally rated load, and to have sufficient capacity to stand overloads; second, to open any short circuit which may occur, without injury to itself; and, third, to have the proper automatic attachments so that injury to the motor or apparatus protected is prevented.

In the design of the Condit Oil Switch, for which The Northern Electric & Manufacturing Co., Ltd., are Canadian sales agents, the apparatus is so constructed that these requisites are fully regarded. The first function is amply taken care of by the use of laminated brushes for carrying the current, large studs and heavy terminals. The laminated brush has proven itself the best means of carrying current in a circuit breaker, as is shown by the fact that it is displacing all other types of contacts in open air circuit breakers. On oil circuit breakers, the proposition is exactly the same and the laminated brush is just as successful in this type as in the open air type of breaker. It possesses the further advantage that inasmuch as the contact is horizontal, it not only breaks easily and quickly, but also a slight turning or shifting of the contact does not injure its ability to carry full load.

The second function, the ability to open short circuits, is taken care of in condit circuit breakers by heavy construction by extremely quick break given by the laminated member, and by properly designing the circuit breaker for the particular amount of energy it is supposed to handle. This has resulted in the development of several types of circuit breakers. It is very evident that no matter what the normal load of the circuit breaker may be on short circuits, it is called upon to open the entire capacity of the plant which may be supplying energy at that instant and that, therefore, the type of circuit breaker, that is, whether type "LS" or "D" or "E" in a certain ampere is used, is dependent in a great measure on the amount of energy back of such a breaker, the distance it is from the generating station, and whether it is protected by other circuit breakers in series with it or not. For this reason, heavy 6,600 volt condit circuit breakers are frequently supplied for use on 2,200 volt and similar capacities, where in other places very much lighter breakers of the same normal rating are entirely satisfactory.


Circuit Breaker, Northern Electric and Mfg. Co., Montreal.

The third function, that is, properly protecting the apparatus with which the breaker is installed in conjunction, is taken care of by the arrangement of overload trips, no voltage trips, etc. As a rule a plain overload protection is what is required, although in a great many instances, on motor work particularly, the no voltage protection is growing more and more in favor in connection with the overload protection. Starting rheostats on direct current work are always provided with a no voltage release so that in the event of a cessation of the line voltage the current will be cut off from the motor. Alternating current compensating starting devices, however, have not been successfully provided with these releases, and it is going to be the general custom to make these releases a part of the circuit breaker. The no voltage release which has been developed for the condit circuit breaker and which is now being used on it, although seemingly simple, is really very complex in its action. Some of the difficulties attending the design of the proper no voltage release can be seen when it is realized that the power applied in the form of alternating current is intermittent, while the force tending to release the no voltage release is constant and that, therefore, unless special precautions of some kind are taken there will be set up a humming action so noticable in large alternating current machinery. By the use of massive construction so that the members have considerable inertia and by the use of a solid material of comparitively low magnetic and high electric resistivity, the ordinarily injurious effects of the eddy currents are taken advantage of to produce a practically constant pull. The fact that the no voltage coil has to stand directly across the line has also been taken care of and the release consumes less than 20 watts energy continuously. The further function of the switch in properly protecting its circuit is its inability to be held closed on short circuits or overloads. To obtain this effect, automatic switches are each provided with a mechanism which will allow the switch to open, even though the operator tends to hold it closed on the handle.

All switchboard mountings are also arranged so that in case the switches are tripped automatically, the handle will fly to the open position, thus surely and positively indicating that the switch has been opened.

THOMAS PORCELAINS.

The advantages of porcelain over other materials for the manufacture of insulators is so well known as to require no comment. Not only is the mechanical strength of porcelain greater than glass, but porcelain is not so brittle, and will resist impact much better. Thomas Porcelain Insulators have the advantage over other porcelain insulators that they are burned in kilns heated with natural gas—that no coal is used in their firing and that as a consequence there is no sulphur deposit in the glaze. This use of natural gas also makes it possible to ensure even vitrification, for it is naturally possible to more easily regulate twelve gas flames than twelve coal fires. The kilns are more readily kept at an even temperature.

Thomas Porcelain.

Before being packed and sent out, every Thomas Porcelain Insulator is electrically tested to $2\frac{1}{2}$ to 3 times the line voltage ordered. Where the insulator is made up of multiple parts, each part is individually tested, and then the insulator is afterward tested as a whole. Cementing is invariably done with neat portland cement; no sand is used. All sizes up to and including insulators for a line of 35,000 volts are packed in new, strong barrels. Larger sizes are packed three in a crate, thus enabling quick and easy delivery per pole in line construction.

The two plants of R. Thomas & Sons Co., New York, N.Y., and East Liverpool, Ohio, have in all twenty kilns, thus making them the largest manufacturers on the entire continent of this class of wear. The Northern Electric & Mfg. Co., Montreal and Toronto are Canadian agents for Thomas Porcelains.

PNEUMATIC HOSE COUPLING.

Alexander Gibb, Montreal, has added another article to the lines he handles. This is a patented swivel joint pneumatic hose coupling and which represents quite a radical improvement in this style of article.

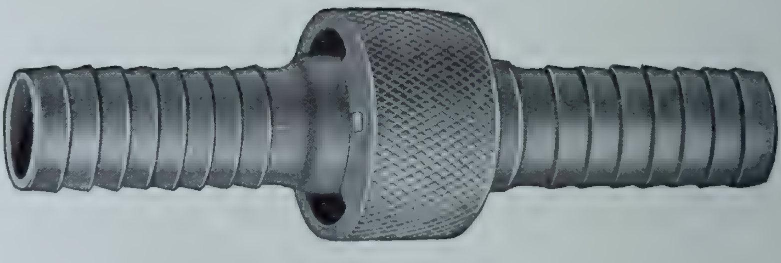
The coupling is made of brass and the important and peculiar characteristics claimed for it include a swivel joint and a one-eighth turn, only to couple or uncouple it. The advantage of the swivel joint is that it eliminates all tendency of the hose to kink. This joint is constructed in such a manner that the packing becomes more and more effective as the pressure increases and there is no dependence made on jamming to make the joint. A powerful spring keeps the coupling securely locked and it cannot be opened by any amount of jarring.

The joints are leather packed without the use of gaskets and, as there is no reduction in size of the interior, full hose opening is obtained.

These couplings, which are sold on a money-back-if-not-as-claimed basis, are made in $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{3}{4}$, 1 and $1\frac{1}{4}$ inch diameters by the Caskey Valve Co., 99 John St., New York.

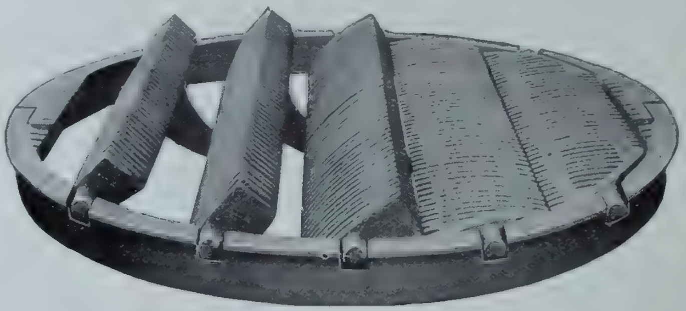
Caskey Air Valve.

This firm have adapted this type of joint and principle of construction to a line of air valves made of manganese bronze in sizes from $\frac{1}{4}$ to 3 inches. Although they were originally designed for hydraulic purposes and developed under a 10,000 pound pressure they are as equally effective under a low pressure.


Swivel Hose Coupling.

IMPROVED GRATES.

The Canadian Steam Boiler Equipment Co., 186 Queen St. E., Toronto, makers of the Cyclone Grate, have placed on the market a new grate, adapted to gas producers, and all vertical boilers. By referring to the illustration it will be seen that the ring is made in two parts, these two parts locking together when placed in position.


Circular Grate, Canadian Steam Boiler Equip ment Co., Toronto.

It will also be noted that the shaking movement of the Cyclone Grate is a feature of the round grate. There is a V cut on the end of the trunions, so that the grate bars rest in the flat sockets on two edges. The shaking, therefore, gives a jarring motion, thus eliminating the use of a slice bar, and does not allow ash or clinker to rest on the centre of the grate box.

The arrangement of a V-shaped trunion resting on a flat socket makes the grate easier to rock, as the trunion rests on two points only, as before mentioned. The shaking arm on the grate bars are of ample length giving a good leverage.

UNIFORM BOILER LAW.

The conference of the boiler inspectors of British Columbia, which was held in New Westminster recently, to consider the recommendations of the Dominion conference at Regina with reference to a uniform boiler inspector act has been concluded. A few amendments have been authorized by the British Columbia inspectors and have been forwarded to the secretary of the conference in Regina.

PROPER TREATMENT OF BELTING.

By Wm. D. Young.

It is to be presumed that the belt maker's treatment in tanning, currying, filling and other processes is the most careful possible for the good of his product. But whether this is true or not, it remains that leather belts are animal tissue, in very durable form, but nevertheless animal, and affected by many conditions which would not injure mineral or even vegetable substances. Used for transmission purposes belts are subjected to tremendous stress. Travelling at extreme speeds the fibres are either under great tension strain or bent back and forth at very quick intervals or both in turning around the pulleys. The atmospheric conditions under which the fibres work are frequently extreme too in that the belt may be subjected to heat, cold, moisture, acid fumes, dust, etc., either constantly or intermittently.

It is only reasonable to believe that belts really do need some treatment; as a matter of actual fact they invariably do.

As further evidence of this: Belts which do not get the kind of food they need, as they get drier and stiffer, do not hug the pulleys, and it becomes necessary to run them tighter and tighter. This not only pulls the elasticity out of the leather (like an old rubber band about a bundle), but adds tremendously to the general friction load of the mill, each belt adding its quota.

A belt preparation to do much good must penetrate into the belt so that the preservative elements go to all of the fibres which make up the belt, and not only to those on the surface, so the whole belt will become and remain pliable, and mellow and the whole belt pull.

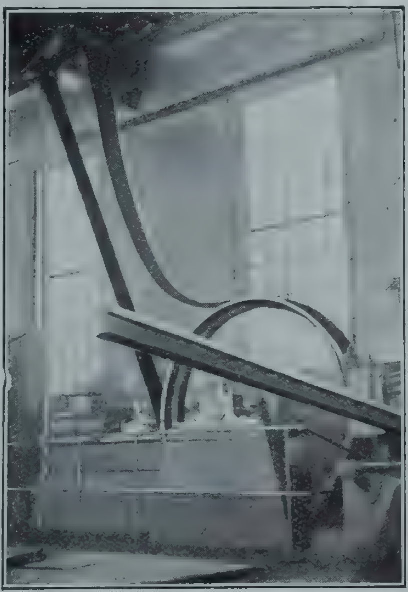
Liquid preparations are better than solid. But provided the material is as pure as it should be, continuously applying liquid to belts tends to make the belt too soft to withstand the continuous and heavy strain.

Neatsfoot oil, which is often used in treating belts, is good, so far as it goes where a pure neutral grade is used, and aside from the above mentioned objection, but it does not go far enough. It simply keeps the belt soft, but does not prevent slip except in so far as a pliable belt will slip less than a dry one.

Semi-solid or paste preparations are believed by most engineers to be best for belts. These must be heated when applied, which is some trouble only for people who look to avoid effort. But nothing worth obtaining is secured without some effort, and maximum efficiency from belts, representing so much investment and on which the proper operation of a plant is so dependent, is worth considerable effort. The more systematically and intelligently this is applied the better the results may be.

The paste should be just dense enough to hold its form at ordinary temperature so that it requires least heat and penetrates most readily, being liquid when heated. Such a paste penetrates the belt as a liquid or nearly so, but when in the belt resumes its semi-solid form at ordinary temperatures and therefore adds weight, density and body to the belt, which is all advantageous.

To be really preservative this paste must surround every fibre of the leather inside and out with a preservative lubricant, so that each fibre works on its fellow in oil bearings instead of grinding. Each fibre is then pliable, mellow and in best possible health, capable of maximum effort and longest possible life.



Belt Treated with Cling Surface.

The ingredients should not be sticky for adhesion means unnecessary strain on the surface fibres and consumes power in ripping the belt off the pulley, as well as collecting dust and forming an artificial surface over the leather surface, which closes the pores, and is not beneficial.

The above information is not moulded to fit any belt preparation, but is a fair, honest exposition of facts, as may be confirmed by asking any experienced belt user. There is, however, in Cling Surface made by the Cling Surface Co., of Buffalo, a belt treatment which fits these conditions admirably, and inasmuch as this preparation has now been in more than twelve years' continuous use by belt owners in all parts of the world, and widely in Canada, it is worth specific consideration.

Cling Surface has just body enough to hold together in the summer, just about like butter. It represent about forty years of experience in the tanning and cultivation of leather plus years of special belt work. It is composed of the most preservative materials made today, and contains no rosin, no gummy oils, less free acid than any other natural or manufactured belt preparations and nothing not preservative. It penetrates all through a leather belt as a preservative should. It does not make the surface sticky, but gives the belt a peculiar cling, which is not sticky. A belt properly treated with Cling Surface has nothing on the outside even though the belt is thoroughly full of it. The Cling is in the surface fibres. The belt surface is therefore perfect and gives a perfect contact, with a perfect metal or wood surface, no air between and cohesion rather than adhesion.

The more perfectly belt slip is prevented artificially (so long as the belt is also preserved), the less tightening tension is needed, and in consequence the more we ease the belt, bearings, shafting and engine, cut down the general friction load and turn power developed from friction to producing output, while saving oil, upkeep, expense and much time, labor and annoyance.

Cling Surface prevents slipping better than initial tension and no such tension is needed on any belt. Every belt can be run easy, some very slack. The slacker every belt can be run the greater the pulley contact and consequently the belt efficiency is greater.

Some get better results from such a treatment than others, for the preparation is used more intelligently. Many people watch their belts constantly, keep all of them treated to perfection always, and invariably get splendid results. Others use it occasionally and get results which are valuable though less spectacular. But in every instance under ordinary plant conditions careful and continuous belt treatment will pay and pay well.

The illustration shows a boiler shop belt in plant of a prominent railroad, showing what may be accomplished by careful treatment of an almost vertical belt. This is a 12-inch double belt running from 6 feet 8-inch driver to 30-inch driven pulley on 19½-foot centres. The pulley wrap is now 5-6ths diameter of the driver pulley and there is no slip even under greatest load. Photo was taken while running at full speed. Note how smoothly the slack side of belt leaves the pulley.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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ONTARIO'S BOILER ACT.

The Ontario Legislature has enacted "The Steam Boiler Act" respecting the construction of boilers. In this act "steam boiler," is referred to as a boiler for generating steam for heating and power purposes, and every part thereof or thing connected therewith, and apparatus and things attached to or used in connection with any such boiler, but shall not include a boiler used for heating water for domestic purposes, or a railway or steamboat boiler."

Upon the recommendation of the Minister of Public Works the Lieutenant-Governor is empowered to make such rules, regulations and specifications as may be deemed proper respecting the construction of steam boilers, including the material to be used, the method of construction, the tests to be applied, the inspection of the boiler during its construction and before it is permitted to leave the place of construction, and generally such other matters as may secure a uniform standard of strength, safety and efficiency.

The rules, regulations and specifications shall be published in the Ontario Gazette, and shall come into force and take effect at a date to be named by proclamation.

This law and uniform regulations were recommended to the Ontario government by Duncan N. Medcalf of the Department of Public Works, who represented Ontario at the Regina conference. A board of inspectors will be appointed and it is expected that Mr. Medcalf will be chief of the board. Such an appointment would be received with satisfaction by both Ontario boiler makers and users.

◆

SECRET COMMISSIONS ACT.

His Lordship, Justice Magee says it is illegal for a purchaser to accept a secret rebate. The Secret Commissions Act makes no distinction between receiving and giving a secret commission.

Justice Magee says: "If you sent your servant to market to buy a horse and there he meets with a man who offers him a horse at $150 and says, 'If you will buy this horse at $150 I will give you $10 of it to yourself; and you need not have any compunction about it, because I would not let your master have it for less than $150.' And your servant gets it for $150 and puts the $10 in his pocket, you can recover that $10 from your servant. It is your money, not his, because it was made out of the transaction which he was carrying on with some person else for you; now, that is clear law. So, a commercial traveler sent out by a house here in Canada to buy goods for that house in the States, and he may be offered a commission by a person in respect to the goods he buys. When he comes back to Canada, if the transaction ever becomes known, he is liable to pay over that money to his employers. He has no right to be paid at both ends, unless it is known. This question of double commissions has for a long time past been quite too common, and has been permeating to a large extent the commercial life of the country. So much is that the case that last year the Dominion Government passed an act making it a criminal offence to take a double commission."

Let us see whether the other half of the act is not just as binding on the giver of the secret rebate as it is on the receiver. Clause (b) reads as follows: "Being an agent, corruptly gives or agrees to give or offers any gift or consideration to any agent as an inducement or reward or consideration to such agent for doing or forbearing to do, or for having after the passing of this Act done or forborne to do, any act relating to his principal's affairs or business, or for showing or forbearing to show favor or disfavor to any person with relation to his principal's affairs or business."

It must be evident from the above that the object of the law is to prevent the seller from giving a secret commission. So that the traveler who gives a secret rebate or other consideration is clearly violating the act.

So far as the liability of the person who accepts the secret rebate is concerned, clause (d) covers that. It reads: "Every person who is a party or knowingly privy to any offence under this act shall be guilty of such offence and shall be liable upon conviction to punishment hereinbefore provided for by this section."

So that an engineer or any other person who accepts a secret commission or consideration is guilty under the provisions of the act and liable to the penalties it imposes.

The Power House is pleased to know that its position has been so fully endorsed by such an eminent authority as Justice Magee. We are especially pleased because it tends toward honesty in business and it should, therefore, be hailed with pleasure by every honest person in Canada.

FOUND MONEY.

No soot—Twenty cents a day saved. No boiler scale—Ten cents a day saved (difference between keeping feed water pure and scale out of tubes and a dirty boiler.) No oil in feedwater—Nine cents a day saved. Lots of air, good equipment—Fifteen cents a day saved.

.20
.10
.09
.15
.54
300
$162.00

That is how it piles up with only a very small saving each day. Did you ever figure it out how a small improvement in equipment, the introduction of a different system or using the results of others' experience saves money and piles up a good profit in the power plant.

Some manufacturers look upon the boiler as a gaping hole into which all profits are shovelled and consumed. But what are the facts. The intelligent fireman is a profit maker. He can furnish power at a minimum cost thus allowing the manufacturer to take contracts that previously he could not consider. An engineer can run a plant economically and furnish the profits for the factory where before the power plant was only considered as an item of expense.

It has puzzled hundreds who were anxious to instal a new piece of equipment in the engine room. Take an Indicator for instance costing twenty-five dollars. The engineer is able by its use to keep the valves set properly and make a saving in steam which reduces the coal bill.

Let us forget the twenty-five dollars and think of the coal saved by the engine taking only the actual amount of steam required. Suppose you save ten cents each day. Now do a little rapid calculation.

.10
300
$30.00

In less than a year the indicator is paid for. It then earns money for you. That is what we call found money. Look over your plant and perhaps there are some improvements you can make which will yield you a handsome profit.

WHERE ARE THE VALVES?

Here is an idea which should claim the attention of every engineer, superintendent and foreman. At a meeting of the American Society of Mechanical Engineers last year a suggestion was made to use a definite code of colors in painting power house piping. The idea is an excellent one that could easily be carried out.

A chart of the works could also be made showing the location of all pipes. The colors on the charts would correspond to the color of the pipes in the power plant and works. Such an arrangement would be of the greatest benefit in tracing pipes and locating valves. The chart should be brought to the attention of every engineer, superintendent and foremen, so that each one would know exactly where all valves are located.

If a break occurs in a steam pipe and no one knows where the valves are, and the pipes are run underneath the floor or anywhere, there is a rush to find the valve. A valve is found but no one knows which one it is and it is turned off. At the same time another discovers another valve and it is turned off, yet steam still issues from the broken steam pipe, scalding men and carrying destruction with it.

If different pipes have their distinctive colors, a different picture presents itself. Anyone can trace the pipe by its color and the valve belonging to the pipe can easily be located.

Then again, if a break occurs in an underground pipe, and if there is no chart, no one knows where the pipe enters the building. The pipe was laid by a contractor and no one paid any attention as to its location. It is therefore essential in case of accident, that every factory should have a map of the power plant and factory showing the location of all piping, its use, size, depth, etc. They will then be prepared for any accident that might occur and damage to valuable machinery and injury to men will be reduced to a minimum.

"THE POWER HOUSE" IN THE SOUTH.

The many friends of "The Power House," both readers and advertisers, will be pleased to learn of the interest our Southern cousins in British Guiana, S.A., and the West Indies are taking in Canadian power papers.

Our special representative, David Williams, is meeting with continued success. A letter has just been received from British Guiana, containing fifteen subscribers for "The Power House" and Mr. Williams writes that this is only the result of the first few days' work. He will spend some time yet in the south before returning to his work in the north.

THE MAN WHO DOES.

To-day the man who *does* is the only one who is recognized.
What he has been or what he has done—
What he expects to do in the future—all these make a pretty story.
But we like the sound of the footsteps of the man with red blood in his veins—
The man with fire in his eyes, energy in his movements.
Not a man who *expects* to do—some day,
But the man who is doing things—*now.*
—*Obermayer.*

*The Construction and First Inspection of Steam Boilers

These Regulations were Agreed upon by Represenatives from British Columbia, Alberta, Saskatchewan, Manitoba and Ontario, and a Represenative of the C.M.A. at a Conference in Regina, Decmber, 1909.

Registration of Designs.

Before commencing work on any boiler to be built under these regulations three drawings of the same, with specification form in duplicate, must be submitted to the Department for approval of the pressure and arrangement of the boilers, which must comply in all cases with these regulations and the Act.

This applies also the designs for safety valves and other fittings. Approval or corrections will promptly be given or pointed out in the order as applications are received by the Department and the manufacturers advised accordingly.

Each drawing must have on it a complete list of parts of boiler with identification numbers on it and the details shown, the material and sizes being given on specifications. To prevent delay any manufacturer must submit for approval designs of manufacture which, when finally approved, will be given registration numbers for the province and from which boilers may be made by that manufacturer in any number, full reference being made to the registration when sworn construction certificates are sent to the Department concerning such boilers; and further provided, that no change in these regulations shall affect such design until after twelve months' notice has been given to the manufacturer of such change, but any new designs submitted for approval after notice of change in regulations has been given must be in accordance with such change.

Three drawings or blue prints of each design submitted must accompany an application for its approval, each having a blank or white space on it five by four inches in size; one of these drawings or prints will be returned to the manufacturer. Chnages in design necessitate submission of same for approval and fresh registration.

On application to the Department, manufacturers may be given or allotted a series of identification numbers for construction of their standard approved boilers.

Identification.

Every boiler built under these regulations shall be stamped on the plates of the boiler in the place hereafter indicated as follows, in figures at least one-quarter inch in size:

(a) Builders' number and initials.

(b) Provincial letter and registration number of design;

(c) Lowest tensile strength of any shell plate in the boiler with "S" for steel, and "I" for iron;

(d) The initials of the person giving the certificate and identification number, or initials of persons giving affidavit of construction;

(e) The date of construction, thus: Day of month, numerical order of month, last two figures of year.

A sample stamping would be as below, it being stamped legibly and fully into a plate of the boiler itself (not the smoke-box):

(a) X.Z.Co. 777.
(b) O. 134 (for Ontario).
    A. 555. (for Alberta).
(c) 55000. S.
(d) H.W. (472).
(e) 26.10.10.

When either of the above are left out the corresponding space must be left blank.

The locations of stampings shall be as follows:

On horizontal return tubular boilers on centre of front head above tubes.

On portable and locomotive types, on right side of fire door, clear of attachments.

On water tube boilers, on the end of steam drum above man-hole door.

On internally fired boilers with circular furnaces, on right side of fire doors if practicable.

On vertical boilers, on right side of fire doors.

For boilers where location is not practicable as above, it must be indicated by specification.

Design.

Cylindrical portions of boilers, such as shells or barrels, domes, drums or reservoirs, shall be made as nearly as possible truly cylindrical.

All surfaces formed to a true circular curve except surfaces otherwise privided for shall be calculated in a similar manner to cylindrical shells, but when they or other parts are not so made or are parts of true cylinders of different radii, they must be treated as flat surfaces and stayed accordingly and in any case at the change of curvature.

Thickness of Plates.

The minimum thickness of any plate used in the construction of a boiler under these regulations shall be one-fourth (¼) of an inch, and in all cases the thickness of boiler heads having a diameter up to 40 inches shall be not less than 5-16 inches; diameters from 40 inches to 52 inches not less than ⅜ inches; diameters from 52 inches to 60 inches not less than 7-16, and not less than 1-16 additional thickness for every 6 inches additional diameter for boilers above 60 inches diameter.

The thickness of all plates in shells or drums shall be alike and that required for the working pressure of any part according to formula hereafter given, but must be not less than one-quarter inch.

The minimum thickness of plates in stayed surface construction shall be five-sixteenths (5-16) of an inch.

Seventy-two inches shall be the maximum diameter for all externally fired boilers.

Reinforcing Plates.

For standard water pipe one inch in diameter, and for standard steam pipes one and one-quarter (1¼) inches to two inches in diameter the opening shall be reinforced with a plate securely riveted; the threads made continuous and full size, through both plates, the pipe fitting tightly in both; above two inches in diameter, flange nozzles with bases riveted to the boiler must be used. Other openings in cylindrical parts of boilers or in drums shall be reinforced in all cases, when their measurements exceeds two and one-half (2½) inches in line with the longitudinal axis of same, or three and one-half (3½) inches circumferentially.

All reinforcing rings or plates must have proper curvature and be fitted closely to the plates they reinforce and must be of at least the same thickness. There shall not be less than three-eighths of a square inch net section of solid plate round any hand-hole, man-hole or other opening in any part of a bailer.

Reinforcing Plates Where Brackets are Attached.

In all cases where brackets or other fixtures subjected to any working strain are attached to a traction or portable boiler, the plates to which these brackets are attached shall be reinforced with plates of the same thickness as the outer plates and properly riveted together, the outer rows of rivets attaching reinforcing plates must be outside the bracket. All brackets shall be properly fitted (without white metal or other filling) to the plates, flat or curved, with stud holes drilled to suit the holes in brackets, which must be drilled to templets and the studs attaching same shall be tapped through both plates where reinforced. (No cap screws will be allowed.)

Man-holes.

All boilers shall be provided with the prescribed number of man-holes of standard size, strengthened with reinforcing ring cut from boiler plate of at least the same thickness as the shell, and equal, exclusive of rivet holes, to the area of section cut from shell in line with its longitudinal axis, riveted around the man-hole opening, and the man-hole doors are to be provided with two bolts having a shoulder on the outside screwed through the door and riveted on the inside. The possible lateral motion of door in man-hole must not exceed one-eighth of an inch.

A flange formed inwards on the reinforcing plate to receive the door is required. The reinforcing plate must be placed on the inside of boiler except in

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* These regulations are not in force in any province, and will not be until issued by the proper officials of such provinces as decide to adopt them. It is hoped that all the provinces will isssue such uniform regulations, to become effective during the year 1911. Ontario has passed a boiler act and these regulations shall take effect at a date to be published in the Ontario Gazette.

boilers under forty-two (42) inches diameter, when it may be placed outside.

The rivets holding reinforcing rings to shell must be sufficient for caulking purposes, but their area in no case shall be less than one hundred and twenty per cent (120 per cent.) above the net sectional area of part cut from shell in line of its longitudinal axis.

(a) There shall be a standard manhole in the upper part of the shell of a fire-tube boiler 42 inches and above in diameter, excepting vertical fire-tube boilers, where the furnace or tubes prevent access to the interior of the boiler.

(b) Horizontal boilers 48 inches in diameter and upwards shall contain two man-holes not less than 10 inches by 15 inches in the clear, one in the front head below the tubes and one in the shell above the tubes. In boilers sixty-six (66) inches and above in diameter man-holes shall be 12 by 16 inches in the clear. All man-holes in flat surfaces must be flanged from solid plate inwards.

(c) All man-hole flanges must have a ring not less than three-quarters (¾) inches by one and one-half (1½) inches securely shrunk round flange, which shall be faced to form a joint.

Hand-holes and Wash-out Plugs.

All cylindrical horizontal boilers less than 42 inches in diameter must be provided with a hand-hole in each head below the tubes.

All other types of boilers must be provided with sufficient mud-hole or hand-hole and washout plug openings to provide for properly cleaning and inspecting every part of the boiler. When mud-hole openings are threaded for plugs the plugs must in all cases be of brass.

Hand-holes and Washout Holes in Loco Type.

A locomotive type boiler shall be provided with sufficient hand-holes or wash-out plugs to allow the whole of the interior to be inspected and for washing out.

In no case shall there be less than six hand-holes or less than twelve such openings in all, the whole to be located as approved in design and due regard had to facility of access when the machinery or other attachments are mounted on the boiler, great care being given to secure the best arrangement for cleaning the interior of the boiler. Wet bottom boilers must have a plug in the lowest part of shell and have a drainage tube in bottom to drain ashpan.

Fire-hole Doors.

Fireholes in vertical, portable, traction and locomotive firebox boilers must not be less than 10 inches by 15 inches, or equivalent area, if the maximum dimension is not less than fourteen (14) inches, in the clear, to allow for examination of firebox.

Handholes in Vertical Boilers.

All vertical firetube boilers shall have not less than seven openings for cleaning out purposes, located as follows: One (1) at the water line four inches by six inches, three (3) in line with the lower tube sheet, two (2) at bottom of water leg, one (1) small plug under firehole door; boilers exceeding 36 inches in diameter shall contain one extra 4x6-inch handhole located at the water line.

Minimum Diameter of Stay—Screwed Stays to Have Substantial Heads.

No stay less than seven-eighths (⅞) inch as measured over the threads shall be used in the construction of any boiler. Screwed stays (not fitted with nuts) must be thoroughly fitted in the sheets, be well set up, and the ends well riveted over to form good substantial heads, but standing not more than two and one-half or less than two threads above the sheet at their centres when screwed home before riveting. The number of threads per inch shall not exceed twelve or be less than eleven in any plate or shell in a boiler except for standard steam and water pipe sizes. The use of the Whitworth type of thread is recommended.

Maximum Stress on Stays.

Iron—

For screw stays and other stays which have been welded, 5,000 pounds per square inch net section will be the maximum stress allowed. For screw stays and other stays not welded, 7,000 pounds per square inch net section will be the maximum stress allowed.

Steel—

For screw stays and other stays less than one and one-half (1½) square inches net sectional area, 8,000 pounds per square inch will be the maximum stress allowed. For all other stays 9,000 pounds per square inch net section will be the maximum stress allowed.

Steel stays may be upset at ends, but not welded in any way. The ends of longitudinal stays should in all cases be upset for threading to ensure the net section being not less than that of body of stay.

They must not be riveted over on the sheets.

Holes in sheets for stays not screwed into or riveted to plates must not be more than one-sixteenth (1-16) of an inch larger than the diameter of the stay and be finished by reaming or by a rose cutter or drilled.

Stays must be arranged so as to admit of free access to the interior of the boiler.

Domes on Cylindrical Parts of Boilers and Openings for Other Purposes.

Any opening for domes, manholes, handholes, or for other purposes on shells or cylindrical parts of boilers must have its shorter axis in line with the longitudinal axis of same, and when that is over two and one-half inches be reinforced by a plate riveted after careful fitting to the shell ,around the opening. The reinforcement must be equal in cross section and strength, exclusive of rivet holes to the section of plate, cut out of shell or covered by the dome in line with its longitudinal axis. The combined area of rivets securing the reinforcement to shell must be, exclusive of those necessary to hold dome to shell, twenty per cent. (20 per cent.) in excess of the area of section so removed or measured.

Maximum Working Pressure Allowed on a Boiler.

The maximum working pressure to be allowed on the shell of a boiler constructed of steel or wrought iron shells or drums, shall be determined from the minimum thickness of the shell plates, the lowest tensile strength stamped on the plates by the plate manufacturer, or as established by authoritative test, the efficiency of the longitudinal joint, the inside diameter of the outside course, and the lowest factor of safety allowed by these rules, the formula being:

$$B = \frac{2T \times TS \times K}{Dr \times F}$$

B=Maximum allowable working pressure in pounds per square inch.
T=Minimum thickness of shell plate in inches.
TS=Tensile strength of plates in pounds.
K=Efficiency of longitudinal joint.
Dr=The inside diameter of the outside course of the shell or drum expressed in inches.
F=Lowest factor of safety allowed by these regulations.

Factors of Safety.

Boilers well designed, well constructed and made of good material should be allowed a higher working pressure than boilers inferior in any of the above respects, and unless this is done the superior boiler is placed at a disadvantage, and good workmanship and the use of good material will be discouraged.

To provide for the above, the following rules regarding factors of safety for cylindrical boilers and cylindrical parts of boilers have been adopted.

When cylindrical sheels of boilers are made of the best material (either iron or steel), with all holes drilled in place, the plates afterwards taken apart and the burrs removed, and all longitudinal seams fitted with double butt straps, each at least five-eighths the thickness of the plates they cover, the seams being double riveted with rivets having an allowance of not more than 75 per cent. over the single shear, and having the circumferential seams constructed so that the percentage is at least one-half that of the longitudinal seams, and provided that the boiler has been inspectors authorized by the Act during the whole period of construction in accordance with these regulations then 4.00 may be used as a factor of safety. But when the above conditions have not been complied with, the additions in the following scale must be added to the factor of safety, according to the circumstances of each case:—

To be added to factor of 4.00.

A .10 Holes in longitudinal seams, fair and good but drilled from solid out of place after bending endges of plates.

B .20 Holes in longitudinal seams, fair and good drilled from solid out of place before bending edges of plates.

C .20 Holes in longitudinal seams, fair and good punched after bending edges of plates and reamed after assembling.

D .30 Holes in longitudinal seams, fair and good punched before bending edges of plates and reamed after assembling.

E .07 Holes in circumferential seams, fair and good, drilled from solid out of place after rolling plates.

F .10 Holes in circumferential seams, fair and good, drilled from solid out of place before rolling plates.

G .10 Holes in circumferential seams, fair and good, punched after rolling plates and reamed after assembling.

H .15 Holes in circumferential seams, fair and good, punched before rolling plates and reamed after assembling.

I .70 In longitudinal seams, if double butt straps are not fitted, and and the said seams are lap and double riveted.

J .50 In longitudinal seams, if double butt straps are not fitted and the said seams are lap and treble riveted.

K .60 In longitudinal seams, if only single butt straps are fitted and the said seams are double riveted.

L 1.00 In longitudinal seams, when any description of joint is only single riveted or when double butt straps are used and only one row of rivets is in double shear.

*M .50 Holes or rivets in longitudinal seams, not fair or not good.

*N .20 Holes or rivets in circumferential seams, not fair or not good.

O .40 Holes in any seams not properly spaced in crossing.

*P .40 When material is doubtful and not properly certified in accordance with regulations.

*Q .50 If joints are not close fitting, the plates being open when boiler is finished or workmanship unsatisfactory.

R 1.00 If boiler has not been inspected by inspectors authorized by the Act during the whole period of construction in accordance with these regulations.

Where marked * the inspector may according to circumstances increase the factor given, and in the event of satisfactory information not being obtainable the inspector shall use a basic factor of safety of five (5) with such additions as his judgment may dictate.

In the foregoing A, B, C, D, E, F, G, and H, must be used separately, but may be added, when justified, to either I, J, K, L, M, or N separately, and to O, P, Q, or R separately or to the whole four latter when calculating the efficiency of a joint.

Symbols.

The following symbols are used in these regulations and the application of the formulae and have the meaning as set opposite them.

A=Total area of a part of a boiler requiring staying.

a =Cross sectional area in square inches of one stay or one rivet after driving.

B=Maximum working pressure allowed on a boiler.

c =A chord of a segment of a circle.

C=A constant as used in a formula.

D=Distance in inches.

Di=Distance in feet.

Dr=Diameter.

dr=Diameter of a tube in a boiler.

d =Diameter of a rivet after driving.

E=Area supported by one stay or one rivet when more than one rivet in stays.

F=Factor of safety.

g =Depth of girders.

H=Length of diagonal stays measured in line with stay.

h =Versed sine or height of a segment of a circle whose boundaries are already defined.

K=Efficiency of a riveted joint, that is the proportion which the weakest part of a joint bears to the solid plate in the same unit of measurement which may be Kt, Ks or Kst, the strength of the solid plate being taken as 1.0.

Kt=Efficiency of a joint when the strength of the plates alone is taken into consideration.

Ks=Efficiency of a joint when the strength of the rivets alone is taken into consideration.

Kst=Efficiency of a joint when a combination of plate and rivets at a point where they are the weakest in such combination is taken into consideration.

L=The length of a line drawn at right angles from the surface to be supported to a point on this line at a right angle from it to the end of a diagonal stay, of a riveted joint or in a stay.

Li=Length in feet.

l The length of E in inches.

N=The number of supporting bolts or stays in a given area.

n =The number of rivets in single shear in a unit of length.

ni =The number of rivets in double shear in a unit of length of a riveted joint or in a stay.

P=Pitch of rivets in inches in outside row when calculating efficiency of joints.

p =Pitch of stays in stayed surfaces when equally spaced in both directions.

PD=Minimum diagonal pitch in inches between inner and middle rows of rivets, when three rows in staggered butt strap joints.

pD=Minimum diagonal pitch in inches between staggered rows of rivets in lap joints and double riveted butt joints and between outer and middle rows of rivets in treble riveted butt joints.

PM=Maximum pitch of rivets in riveted joints immediately inside the caulking edge or edges.

R=Radius.

s =Strength of rivets in single shear.

S=Strength of rivets in double shear.

Tw=Tensile working stress.

Ti=Thickness in inches for butt straps.

TS=Tensile strength of material, admitted or approved.

T=Thickness of plate in inches.

t =Thickness of plate in sixteenths of an inch.

V=Minimum distance in inches between staggered rows of rivets in lap joints and double riveted butt joints and between outer and middle rows in treble riveted butt joints.

Vi=Minimum distance in inches between inner and double rows of staggered rivets in treble riveted butt joints.

W=Distance in inches when D is also used in same formula.

w =Width of E in inches.

Maximum Pitches for Riveted Joints.

$$(C \times T)+1\tfrac{5}{8}=pM.$$

When

T=Thickness of plate in inches.

pM=Maximum pitch of rivets in inches (not to exceed ten inches) immediately inside the caulking edge or edges.

C=Constant applicable from the following table:

No. of rivets in one pitch.	Constant for lap joint.	Constant for double butt strap joints.
1	1.31	1.75
2	2.62	3.50
3	3.47	4.63
4	4.14	5.52
5	——	6.00

When work is first class such pitches may be adopted, far as safety is concerned, yet, in some cases, it may not be well to adopt the greatest pitch found by the formula. The maximum pitch should not exceed ten inches with the thickest plates for boiler shells.

The lap outside rivets measured from the rivet hole to edge of plates must be equal to diameter of rivet hole.

The minimum diameter of rivets in riveted joints shall be five-eighths of an inch ($\frac{5}{8}$") after driving and in no case less than the thickness of any one plate in joint.

Rivet Heads.

The button head or partly spherical form of ordinary rivet heads is recommended made to the sizes given below.

Size	Button Heads		Countersunk	
Diameter of rivet before driving	Height	Diameter at base	Depth	Diameter of outside of sheet
5 8"	15/32"	1 1/8"	5/16"	1"
3 4"	9/16"	1 5/16"	3/8"	1 3/16"
7/8"	21/32"	1 3/4"	7/16"	1 3/8"
1"	3/4"	1 1/2"	1/2"	1 9/16"

Efficiency of Riveted Joints.

The efficiency that a unit of length of a riveted joint has to the same unit of length of the solid plate of which that joint is composed shall be calculated by the following formulae:

In the following formulae the strength of rivets in double shear is taken as being 1.75 times their strength in single shear.

$$C = \text{a constant} = \frac{\text{shearing strength of rivets per square inch}}{\text{tensile strength of plate per square inch}}$$

and may be taken at

.85 for iron rivets in iron plates.

.70 for steel rivets in steel plates.

.65 for iron rivets in steel plates.

For full description of symbols and their meaning see table of symbals, page 62.

Chain riveted joints are prohibited for use under these regulations, which allow for use in boilers only the staggered types of riveting and limit the number of rows of effective rivets in joints to three, whether in lap or butt strap construction.

K = efficiency of joint.

Kt = efficiency of plate in joint.

Ks = efficiency of rivets in joint.

Kst = efficiency of combined plate and rivets in joint.

K = Kt, Ks or Kst, whichever is least.

Single Riveted Lap Joint.

$$Kt = \frac{P-d}{P}$$

$$Ks = \frac{a}{P \times T} \times C.$$

a = area of one rivet in single shear.

Double Riveted Lap Joint.

$$Kt = \frac{P-D}{P}$$

$$Ks = \frac{2a}{P \times T} \times C$$

2a = area of two rivets in single shear.

Treble Riveted Lap Joint.

$$Kt = \frac{P-d}{P} \qquad P = \text{pitch on outer row.}$$

$$Ks = \frac{3a}{P \times T} \times C.$$

3a = area of three rivets in single shear.

Single, double or treble riveted joints with single butt straps shall be considered equal respectively to single, double or treble riveted lap joints.

Double Riveted Butt Joints With Equal Straps and Equal Number of Rivets in Each Row.

$$Kt = \frac{P-d}{P}$$

$$Ks = \frac{3.5a}{P \times T} \times C$$

3.5a = area of two rivets in double shear.

Treble Riveted Butt Joints with Unequal Straps and Every Other Rivet Omitted in Outer Row.

$$Kt = \frac{P-d}{P} \qquad P = \text{pitch on outer row.}$$

$$Ks = \frac{8a}{P \times T} \times C$$

8a = area of four rivets in double shear plus one rivet in single shear.

$$Kst = \frac{(a \times C) + [(P-2d) \times T]}{P \times T}$$

a = area of one rivet in outer row in single shear.

Distance Between Rows of Rivets.

$$V = \frac{\sqrt{(11\ P+4d)\ (P+4d)}}{10} =$$

Minimum distance in inches between rows of rivets for lap joints and double and treble riveted butt joints with full number of rivets in all rows.

$$V = \sqrt{\left(\frac{11}{20}P+d\right)\left(\frac{1}{20}P+d\right)}$$

Minimum distance in inches between outer and middle rows of rivets for treble riveted butt joints when every other rivet is omitted in the outer row.

$$Vi = \frac{\sqrt{(11\ P+8d)\ (P+8d}}{20} =$$

Minimum distance in inches for treble riveted butt joints between inner and middle rows when every other rivet is omitted in outer row.

$$PD = \frac{3P+4d}{10} =$$

Minimum diagonal pitch in inches for treble riveted butt joints between inner and middle row when every other rivet is omitted in outer row.

$$pD = \frac{6p+4d}{10} =$$

Minimum diagonal pitch in inches for all rows in double and treble riveted lap joints also for double and treble riveted butt joints with full number of rivets in all rows.

$$pD = \frac{3}{10}P + d =$$

Minimum diagonal pitch in inches for outer and middle rows of treble riveted butt joints when every other rivet is omitted in outer row.

Butt Straps With Full Number Rivets in all Rows.

$$Ti \text{ for double butt straps} = \frac{5\times}{8}$$

$$Ti \text{ for single butt straps} = \frac{9 \times T}{8}$$

Double Butt Straps—When Every Other Rivet is Omitted in Outer Row.

$$Ti = \frac{5 \times T \times (P-d)}{8 \times (P-2d)}$$

Longitudinal Seams.

All longitudinal seams of horizontal boilers shall be above the centre line of boiler, no longitudinal seam of any boiler shall have a continuous length of more than ten (10) feet and thirty degrees (30) shall be the difference in location of such seams (where more than one) on the cross section of boiler.

Circular Heads Either Dished or Flat.

Convex heads when dished to a radius equal the diameter of the shell or drum to which they are attached, or less, and when they are also true portions of spheres do not require staying if their thickness is one-sixteenth of an inch more than the shell or drum plate, as found by the formula for maximum pressure allowable on a boiler.

The pressure allowable on heads which are dished to radius greater than the diameter of shell to which they are attached is obtained as follows: Being limited to that allowable for the shell to which they are attached and stayed as flat surfaces when thickness of head does not make "B" to equal that allowed for shell; but the resistance to rupture or collapse as found by the following formula may be considered when calculating the stays required.

$$B = \frac{(t-1) \times TS}{R \times 56}$$

B = pressure allowable in pounds per square inch.

t = thickness of plate in sixteenths of an inch.

TS = tensile strength of plate.

R = radius to which head is bumped.

h = camber or height of bump measured from chord "c."

c = diameter of spherical portion of head exclusive of radius at flange.

$$R = \tfrac{1}{2}\left(\frac{(\tfrac{1}{2}c)^2}{h} + h\right)$$

will give radius to which a head is bumped care being taken to measure h and c correctly.

Concave heads are to be considered as only sixty per cent. (60%) of the strength of convex after calculating as above. The circumferential joints for all such heads should be carefully calculated, being at least fifty-five per cent. the value of the solid plate, and double riveting used where practicable.

Flatheads.

Flatheads not used as tube sheets are to be stayed by through or diagonal stays, the area to be stayed being determined as follows. When the head is flanged and riveted to the shell, a portion of it becomes stiff enough to carry the boiler pressure without depending upon the braces. The distance that thus becomes self-supporting may be determined by the following formula:

The allowance in inches for shell as stay to head to equal

$$\tfrac{1}{2}\sqrt{\frac{112\times t^2}{B}}$$ or radius of curvature of head flange whichever is greatest.

t = thickness of head in sixteenths of of an inch.

B = working pressure.

Area of Head to be Stayed.

When the area of any segment of a head to be stayed is required, one of the following formulae shall be used:

$$A=\frac{h^3}{2c}+\frac{2c\times h}{3}\text{ or }\frac{4h^2}{3}\sqrt{\frac{2R}{h}-.608}$$

h = height in inches of segment to be supported.

c = length in inches of chord of segment to be supported.

A = area of the segment in square inches.

R = Radius in inches of segment to be supported.

The pitch of stays is governed by the manner in which they are attached to the head. When riveted to head the area of rivets must be twenty per cent. (20%) in excess of the area of stays required.

N = number of stays required.

A = area of head requiring staying in square inches.

a = area supported by one rivet or stay in square inches.

B = working pressure.

n = number of rivets in one stay.

A×B = total stress on stays.

$$\frac{A}{a}=n\times N.$$

$$\frac{A\times B}{N\times C}=\text{area of one direct stay}=E.$$

C = constant for maximum stress per square inch on stays.

= 9000 for steel stays of 1.5 net square inches in net sectional area or over.

= 8000 for steel stays if under 1.5 square inches in net sectional area.

= 7000 for iron stays not welded.

= 5000 for iron stays that have been welded.

Diagonal Stays.

Diagonal (round or square) stays must be increased in area to an amount which shall be not less than the area that would be required for a direct stay multiplied by $\frac{H}{L}$.

When H equals the length of diagonal stays, L equals the length of a line drawn at right angles from the surface to be supported to a point on this line at right angles to the end of the diagonal stay.

The angle which a diagonal stay makes with the shell shall not exceed thirty degrees and should be as much less as possible. Crowfeet welded on flat bar stays are prohibited.

Rivet Area for Stays.

The rivet area attaching stays of all kinds to a head or shell shall aggregate 20 per cent. greater than the stay area. If, however, the ends are attached to angle or tee bars the bolt or pin being in double shear may have an area of 25 per cent. less than the stay, but no allowance is to be made for the value of the bars as stays in this or any other case.

The minimum diameter of rivets attaching stays of all kinds shall be three-quarter (¾) inches.

Gusset Stays.

When gusset stays (which must be attached to plates between two angle irons), are used their area shall be ten per cent. (10%) in excess of that required for diagonal stays, but as diagonal stays can be used in most cases where gusset stays can, they should be given the preference.

The working pressure allowed on gusset stays shall be calculated as follows:

$$\frac{Tw\times W\times T}{E}\times\frac{L}{H}\times .9=B.$$

Where,

E = area in square inches of surface supported.

Tw = working tensile stress in pounds per square inch.

W = width in inches of web of stay at narrowest part.

T = thickness of web.

H = as for diagonal stays.

L = as for diagonal stays.

Flat Surfaces.

The maximum stress allowable on flat plates supported by stays shall be determined by the following formula:

All stayed surfaces formed to a curve the radius of which is over 21 inches, excepting surfaces otherwise provided for, shall be deemed flat surfaces.

$$\text{Working pressure}=\frac{C\times t^2}{p^2}$$

Where,

t = thickness of plates in sixteenths of an inch.

p = pitch of stays in inches when equally spaced in both directions.

C = 112 for screw stays with riveted heads, plates seven-sixteenths of an inch think and under.

C = 120 for screw stays with riveted heads, plates over seven-sixteenths of an inch thick.

C = 120 for screw stays with nut outside sheet, plates seven-sixteenths of an inch thick and under.

C = 125 for screw stays with nut outside sheet, plates over seven-sixteenths of an inch thick and under nine-sixteenths of an inch.

C = 135 for screw stays with nut outside sheet, plates nine-sixteenths of an inch thick and over.

C = 175 for stays with double nuts having one nut on the inside and one nut on the outside of plate, without washers or doubling plates.

C = 160 for stays fitted with washers or doubling strips which have a thickness of at least the thickness of the plate, and a diameter of at least .5 of the greatest pitch of the stay, riveted to the outside of the plates, and stays having one nut inside of the plate and one nut outside of the washer or doubling strip. For t take 72 per cent. of the combined thickness of the plate and washer or plate and doubling strip.

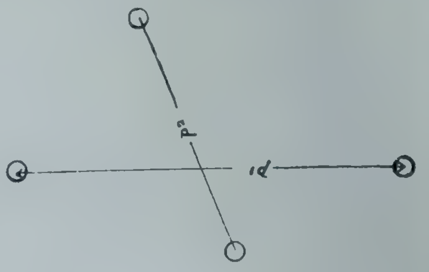
C = 200 for stays fitted with doubling strips which have a thickness equal to at least the thickness of the plate reinforced, and covering the full area braced (up to the curvature of the flange, if any), riveted to the inside of the plate, and stays having one nut outside and one inside of the plates. Doubling plates to be substantially riveted. For t take 72 per cent. of the combined thickness of the two plates.

C = 200 for stays with plates stiffened with tees or angle bars having a thickness of at least the thickness of plate and depth of webs, at least, one-fourth of the greatest pitch of these stays, and substantially riveted on the inside of the plates, and stays having one nut inside bearing on washers fitted to the edges of the webs, that are at right angles to the plate. For t take 72 per cent. of the combined thickness of web and plates. (When the pitches of stays are unequal $\frac{l^2+W^2}{2}$ is to be taken instead of p^2.)

l = the pitch of stays in inches in one row.

w = distance in inches between two rows of stays.

In case of irregular staying as in figure below $\frac{(p1+p2)^2}{8}$ is to be taken instead of p^2.



Tube Sheets.

The minimum thickness for a tube sheet of any size shall be five-sixteenths of an inch (5-16 inch).

The rectangular area covered by the tubes in tube sheets shall, in accordance with the following formula, be considered as stayed by the tubes, but no value is to be allowed for beading as staying, its use being only to protect ends of tubes from fire or rust.

$$\frac{1}{2}\sqrt{\frac{112\times t^{2}}{B}}\quad\frac{dr}{2}=\text{distance in inches from}$$

edge of tube hole to outside edge of rectangular area stayed by the tubes.

t=thickness in sixteenths of inch.
dr=outside diameter of tubes.
B=working pressure.

The minimum size of ligament between any two tubes shall be three-tenths (.3) square inches in section or not less than three-fourths of a lineal inch measurement whichever is greatest for boilers with horizontal tubes. For vertical boilers the minimum size shall be three-tenths (.3) square inches in section or one-half (½) of a lineal inch measurement whichever is greatest.

A greater compressive stress should not be allowed on the upper edges of tube-sheets when crown-sheets are supported by girders, and the ends of such girders rest on the upper edges of tube-sheets, the girders not being supported by sling stays, than as found by the following formula, which limits such compressive stress to 9,000 pounds per square inch of sheet between tubes:

$$\frac{(D-dr)\times T\times 18000}{D\times W}=\text{working pressure.}$$

D=least horizontal distance between centres of tubes in inches.
dr=inside diameter of tubes in inches.
T=thickness of tube plate in inches.
W=distance in inches between tube-sheets and opposite side of combustion or firebox.

The area of the tube-sheet between the upper side of tubes and the bearing point of girder must be sufficient to transmit, without distortion of the tube plate, the stress above dealt with.

Belly Stays.

In boilers thirty-six inches and upwards in diameter, of the loco type, with straight firebox tube-sheets, the portion between bottom tubes and top stay bolts in throat-sheet must be stayed, as for flat surfaces, by belly stays riveted to the barrel, their ends arranged to receive staybolt from tube-sheet.

Internally Fired Furnaces or Parts of Boilers (Other Than Ordinary Fire Tubes) Subject to Compression.

The furnace plates in plain circular internally fired furnaces, not exceeding forty-two inches in diameter or forty inches in height or length, if not found sufficiently strong must be stayed as flat surfaces, allowing in the calculations for such seventy-five per cent. (75 per cent.) of the value of the resistance to collapse as found by the following formula, the pitch of the stays being computed by the rule for flat surfaces, but the pitch shall in no case exceed eight inches on the furnace plate. For furnaces over forty-two inches in diameter or forty inches in height or length, no allowance for value of resistance to collapse shall be made. Care must be taken not to reduce the efficiency of the riveted joint when applying these stays.

$$B=\frac{C\times T^{2}}{(L_1+1)\,Dr}$$

Where—

Dr=outside diameter of furnace in inches.
T=thickness of plate in inches.
L_1=length of furnace in feet, or length between rings.
B=working pressure per square inch, which must not exceed that found by the limiting formula, as follows:

$$\frac{10000\times T}{Dr}=B.$$

C=constant according to the following circumstances:

Furnaces with butt joints and rivet holes punched small and reamed out in place.

112500 where the longitudinal seams are double riveted, and fitted with single butt straps.

100000 where the the longitudinal seam is single riveted and fitted with single butt strap.

112500 where the longitudinal seam is single riveted and fitted with double butt straps, or where seam is welded.

Furnaces with lap joints and rivet holes punched small and reamed out in place.

96000 where the longitudinal seams are double riveted.

87500 where the longitudinal seams are single riveted.

For furnaces of Adamson type, which do not require staying—

$$\frac{9900\times T}{3\times Dr}\times\left(5-\frac{l_1\times 12}{60\times T}\right)=\text{working pressure.}$$

T=thickness of plate in inches.
Dr=outside diameter of body of furnace in inches.
l_1=length between flanges in inches.

Corrugated Furnaces.

$$\frac{14000\times T}{Dr}=B\text{ for steel furnaces.}$$

Where—

T=thickness in inches.
Dr=outside diameter in inches, measured at the bottom of the corrugations.

Truncated Cones.

Flues used in vertical boilers as upper combustion chambers formed in the shape of a frustrum of a cone when new and made to true circles, shall be allowed steam pressure according to the following formula:—

$$B=\frac{(965.625\times t)-(53.045\times l_1)}{Dr}$$

B=working pressure in pounds per square inch.
t=thickness of cone in sixteenths of an inch not to be less than five-sixteenths of an inch.
Dr=outside mean diameter in inches.
l_1=length of cone in inches which must not exceed (135×thickness of cone plate in inches)—12.

When the mean diameter of frustrum of cone exceeds 36 inches, the cone shall be deemed a flat surface and must be stayed accordingly.

Crown-sheets in Loco Type or Other Boiler.

When the tops of fireboxes or of combustion boxes are flat (excepting the outside sheet is parallel to the same) they may be supported by girders properly fitted to the edges of the tube-plate and the back-plate or to the side-plates, as the case may be, by chipping and filing so that a good bearing may be effected on the edges of these sheets and also upon the flanged curve of the crown-sheet. When the tops of fireboxes or combustion boxes are curved they may be stayed by radial or direct stays, which do not enter the sheets at more than five degrees (5 degrees)) from a right angle to a tangent on sheet at point of contact, the pitch and strength of stays being determined by formula. The several rows of longitudinal stays on crown-sheets must make equal angles from vertical centre line with the corresponding rows on opposite side, and their pitch shall be determined by the formula for flat surfaces. No stays shall be permitted to pass between the tubes.

Perfectly flat crown-sheets shall not be allowed in traction and portable engine boilers, and the camber of same as measured from the extension of side sheet to meet the curvature of centre of crown-sheet shall not be less than the width of firebox×.07.

Girder Stays on Crown-Sheets.

The working pressure on girder stays supporting the top of fireboxes or combustion boxes shall be calculated by the following formula, the pitches of girder stays and bolts in same being determined by formula for staying flat surfaces

$$\frac{C\times g^{2}\times T}{(W-p)\times D\times Li}=B.$$

W=width in inches of combustion or firebox in line with girder.
p=pitch of supporting bolts in inches.
D=distance in inches between girders from centre to centre.
L_1=length of girder in feet.
g=depth of girder in inches at centre.
N=number of supporting bolts.
T=thickness of girder in inches.

1200 N

$C=\frac{}{(N+1)}$ when the number of bolts is odd.

$C=\frac{1200\ (N+1)}{N+2}$ when the number of bolts is even.

If the girders are made of steel the value of C is to be increased 10 per cent.

Water Space Between Girder and Sheet.

When the tops of fireboxes are supported by girders there shall be a clear water way between the girders and crown-sheet of not less than 1½ inches and preferably 1¾ inches.

Wagon Tops.

Wagon tops or saddle sheets of boilers are preferably made in one sheet with outside sheets of water legs. When radial stays from crown-sheets enter the wagon top at any point at an angle less than sixty-five degrees (65d.) from a tangent to the wagon top at point of contact the camber of crown-sheet shall be increased to bring the angle within this limit and ensure full threads of stay in wagon top.

Backheads of Loco Type Boilers.

The portion of backhead in a Loco type boiler not stayed to firebox will be stayed under the formula for flat surface.

Throat Sheets.

Throat sheets in Loco type boilers must not be thinner at any point than the sheets they are attached to at the barrel connection. They must be double riveted at barrel connections.

Hydrostatic Tests.

When hydrostatic tests are applied to boilers built according to these regulation they will be made in the ratio of one hundred and fifty per cent. (150%) of the working pressure.

Tensile Strength.

When the actual tensile strength of steel or wrought iron shell plates is not known, it shall be taken as 55,000 pounds for steel and 45,000 pounds for wrought iron, provided sample of material cut from boiler will pass prescribed bending test.

When Special Formula is necessary.

If it occurs that there are parts of any type of boiler for which formula has not been provided in these regulations, the case shall be submitted to the Department.

Workmanship.

The manner in which punching, swaging, cutting and caulking or beading tools, whether hand or machine used, are maintained, also the character of the workmanship generally, will be taken into consideration when determining the factors of safety. No leaks will be permitted to continue.

Plates.

The edges of all plates must be neatly planed, sheared, rolled, bent or chipped, without damaging them in any way.

All plates requiring scarfing must be properly done.

Caulking.

Caulking is to be done by hand or pneumatic hammers and round-nosed tools; caulking edges are to be carefully prepared, the edges being bevelled sufficiently to hold the caulking. The fit of the joint must be made in the laying of the plates, and excessive caulking avoided, and the lower plate not nicked or damaged by caulking tools.

Butt Straps.

Butt straps must be pressed to correct shape and edges of sheets forming joints bent after marking (but before holes are made) to ensure good fitting when assembled and correctness of form. The edges of butt straps must be planed and the joint at connection be protected. The scarfing of butt straps must take in the circumferential rivets.

Holes in Sheets.

The drilling of rivet and stay bolt holes from solid after plates are fitted is preferred, but they may, if not less in diameter than the thickness of the plate, be punched small before rolling after edges of plates are bent. If holes are punched they must for rivet holes up to thirteen-sixteenths (13-16) of an inch in diameter be punched one-eighth inch (⅛'') less, and for rivet holes over thirteen-sixteenths (13-16) inch in diameter be punched three-sixteenths inch less and reamed after assembling to ensure exact size and good, fair holes (all roughness from punching being entirely removed.)

All burrs must be removed, the plates being separated for this purpose.

Joints must be examined after assembling before any riveting is done. When assembled, joints must be close and well fitting, being brought together by fitting up bolts in holes specially prepared. The bringing of plates together by rivets is forbidden. Holes in flanged plates must not be punched or drilled on inner plates until plates are assembled when holes are to be marked off from outer plates, the holes then made and reamed after again assembling.

After reaming, all holes for rivet seams must be fair, punch marks obliterated by it, and so formed that rivet heads will lie fairly to the sheet and be concentric with the rivet.

Holes for stays and stay bolts must be left small for reaming to ensure the threads in both sheets being full and in straight line.

Drift Pins.

Drift pins may be used with light hammers to pull the plates into position, but they must not be driven with such force as to disturb the metal about the hole.

Templets.

The use of permanent steel templets for standard work is recommended, but for other work in quantity one set of plates prepared from which while flat a second set is marked and assembled, the first set if correct being used as templets for the rest, is considered good practice.

Rivets.

Should be driven wherever possible by power riveters; air hammers may be used where practicable. Rivets must be heated their whole length, and be of such length as to fill the hole by upsetting and form full head, being left to cool under pressure of riveter until black.

Flanging Sheets.

Flanging or forming should be done at one heat, where two or more heats occur the whole plate should be heated at the conclusion of the flanging and left to cool slowly and equally, being covered and unexposed to draughts of cold air, the same treatment being given plates flanged in one heat, in which case reheating is not necessary. Sharp corners in flanges must not occur; the minimum radius allowed in flanges is one inch on inner corner in any boiler.

Tubes.

Must fit the holes in tube sheets as nearly as possible before expanding, the end nearest fire being a driving fit when applied. The ends must be prepared for this, and the holes in sheets be truly round, with edges slightly rounded and true to size.

The whole in sheet where tube is entered is to be only large enough to allow free entry of tube.

Tubes must be expanded by roller expanders.

The end of tubes must not extend more than three-sixteenths to one-quarter inch beyond sheet, according to thickness of tube, and then be beaded against tube sheet without cracking, to ensure which the ends of tubes must be annealed.

The hand welding of tubes is prohibited.

Tube Sheets.

All tube holes must be truly round. The holes may be punched one-eighth of their diameter, small and bored to size with a rose cutter. The edges of holes are to be slightly rounded to prevent damage to tubes.

Stays.

All screwed stays must have fall, clean threads, true to size, and where rivetted they must be neatly and carefully finished, the centre of stay in no case standing more than two and one-half or less than two threads above the sheets at their centres when screwed home before riveting, and be free from cracks after riveting.

Where stay nuts are used they must have true and smooth bearing on the sheets or washers when brought up, all threads being true to shape and size.

Material—Plate Makers Name and Tensile Strength.

Every steel plate intended for the construction of boilers hereafter built for operation under the Act must be stamped by the makers with their names and the tensile strength or identification number, the plates being identified by affidavit or inspector's certificate with the mill certificates. The stamps must be so located that they are plainly visible after boiler is constructed.

Steel Plates.

Steel plates are to be homogenous, made by the open hearth process and having the following qualities:

Qualities of Plates and Limits of Same.

Shell plates or plates on which flanging is to be done may have from 55,000 to 65,000 (maximum) pounds per square inch tensile strength, elastic limit not less than one-half the tensile strength, elongation not less than 22 per cent. in 8 inches, cold and quench bends 180 degrees flat on itself without fracture on outside of bent portion. Maximum phosphorus .04 per cent., maximum sulphur .04 per cent.

Firebox Steel.

Firebox plates to have from 52,000 to 62,000 (maximum) pounds per square inch tensile strength, elastic limit not less than one-half the ultimate strength, elongation not less than 26 per cent. in 8 inches, cold and quench bends 180 degrees flat on itself without fracture on outside of bent portion. Maximum phosphorous .035 per cent., maximum sulphur .035 per cent.

Rivet Steel.

Steel for boiler rivets to have from 45,000 to 55,000 pounds per square inch tensile strength, elastic limit not less than one-half the tensile strength, elongation not less than 28 per cent. in 8 inches, cold and quench bends 180 degrees flat on itself without fracture on outside of bent portion. Maximum phosphorous .04 per cent., maximum sulphur .04 per cent.

It must test hot and cold by driving down on an anvil, the rivet being held in a tool ; the head must flatten until its diameter is 2½ times the diameter of the shank (hot test), and 1½ times the diameter of the shank for cold test ; all without developing cracks or flaws.

Wrought Iron.

Wrought iron, where used, must stand the same bending tests as steel when bent lengthwise of plates or bars, but the tensile strength will be twenty per cent., less also the elongation.

The elastic limit will be one-half the tensile strength.

Braces, Stays and Stay Bolts.

All braces, stays and stay bolts are to be made of iron or mild steel specially manufactured for the purpose. Iron shall have a tensile strength not less than 46,000 pounds per square inch, elastic limit not less than 26,000 pounds, elongation not less than 22 per cent. in a length of eight inches. Steel to have a tensile strength of 62,000 pounds maximum and not less than 52,000 pounds, elastic limit not more than 33,000 or less than 26,000 pounds per square inch, elongation not less than 25 per cent. in 8 inches.

Stay Bolt Bending Test.

Material for stay bolts must stand the following bending test : A bar taken at random full threaded must bend cold 180 degrees around a bar of three times its own diameter without showing any cracks or flaws. The use of the Whitworth type of thread is recommended for stay bolts.

Tubes.

Of whatever material manufactured. must be truly cylindrical in form and meet the following physical tests :

For iron and steel the tensile strength, elastic limit, percentage of elongation, etc., must agree with that given for rivet bars.

Any tube must when cold stand without cracking, expanding on a mandril by repeated blows with a hand hammer until it is one-eighth larger than its original diameter.

A piece cut from the tube must flatten closely without cracking, and a piece cut lengthwise from a tube and flattened, bend back on itself both cold and after being heated to a red heat and quenched, without cracking.

Malleable Iron Castings.

Where used must be clean, free from cracks. Samples from material intended for use in boilers constructed under these regulations must stand repeated blows when cold from a hammer without fracture.

Rejection of Material.

In cases where tests show that for stay bars, rivet bars, tubes or malleable iron castings, three pieces (or in cases of lots of 100 or more, three per cent., 3 p.c.) of those subjected to test fail to meet the foregoing requirements, the whole lot so submitted may be rejected.

Cast Iron.

It is desirable that the use of cast iron in boiler construction under the provision of these regulations be discontinued.

It may be used for manhole plates, handhole plates, and nozzles for pressures for pressures not exceeding 100 pounds, but its use for manhole rings, steam domes or like purposes, is prohibited.

It must be clean and of a soft grey texture.

Note —One-half the provinces represented considered the words "for pressure above 100 pounds" should not be included in the foregoing. (See minutes.)

Steel Castings.

May be made by the open hearth or basic process, but must receive such heat treatment as will produce a fine grained, homogeneous and tough metal, free from slag, cracks and cavities, injurious blow-holes and surface or other mechanical defects.

Tensile strength per square inch not below 60,000 pounds.

Elongation in two inches not below 23 per cent.

Reduction in area not below 30 per cent.

Phosphorus not over .06 per cent.

Sulphur not over .06 per cent.

Fittings.

The material of all mountings and fittings must be of good quality and sufficient strength to withstand strains from internal pressure and work for their respective uses, those attached to boilers carrying over one hundred pounds of steam shall be of the class known as extra heavy.

The nipples attaching same, when over one inch in nominal diameter and screwed connections are permitted, must be made of pipe the walls of which are at least fifty per cent. (50 p.c.) thicker than ordinary standard steam pipe.

In applying fittings or their bases when riveted to boiler they must be carefully fitted to boiler riveting, and in case of cast iron a caulking strip of soft steel or iron inserted between the boiler plate and cast iron. The thickness of the flange of any iron casting riveted to a boiler must be not less than three times the thickness of the sheet to which it is riveted.

Fittings must be provided for every boiler as follows :

Safety Valves.

Every boiler shall be provided with a lock pop safety valve of approved design under the following conditions :

The springs and valves are to be cased in, so that they cannot be easily tampered with.

Provision is to be made to prevent the valves flying off in case of springs breaking.

Lifting gear is to be provided to ease all valves.

The springs must have a sufficient number of coils to allow a compression under the working load of one-eighth the diameter of the valve.

The valves are to be provided with metal stops or washers, against which the compression screws abut when the loads sanctioned by the Inspector are on the valve.

With valves over two inches in diameter flange connections must be used.

Area of Valve.

The area of any safety valve, measured at the inside point of contact between the valve and the seat, shall be proportional to the size of the fire grate according to the following formula:

$$A = \frac{37.5 \times G}{B + 15}$$

Where A equals area of valve in square inches at point of contact between valve and seat.

G equals area of fire grate in square feet.

B equals working pressure in pounds per square inch.

Testing Safety Valves.

When considered necessary, the safety valves shall be tested under full steam and full fires for at least 15 minutes with feed water shut off and stop valve closed; if the accumulation of pressure exceeds 10 per cent. of the working pressure of the boiler, a larger safety valve must be substituted.

Twin Valves.

All boilers requiring safety valves to be over three (3) inches in diameter are to be equipped with twin valves instead of one large valve. Where the twin valves, or more than one valve is used, the minimum combined cross sectional area shall be in accordance with formula for same.

No Cast Iron Seat Allowed.

Safety valves having either the seat or disc of cast iron shall not be allowed.

Maximum and Minimum Diameter of Valve.

The diameter of a safety valve used on a boiler shall be not less than one (1) inch or more than three inches.

Location of Valve, Escape Pipe, Etc.

All safety valves are to be fitted independently of any other connection to the boiler, and must be placed immediately at the boiler, and no valve of any description shall be placed between the safety valve and the boiler, nor on the escape pipe between the safety valve and the atmosphere; the escape pipe shall have an open-ended drain at its lowest point. The safety valve shall be located so as to be accessible and must not be connected to an internal pipe in a boiler.

Lifting gear must be provided to ease all safety valves.

Fusible Plug.

Every boiler shall be equipped with at least one (1) fusible plug, which shall be kept in clean and efficient condition. The body of the plug shall be composed of brass with a taper hole through its centre, the smallest diameter of this hole to be at least three-eighths ($\frac{3}{8}$) inch, and to be filled with good bancatin to efficiently protect the fire line, when the water falls below the minimum level prescribed by these regulations, and shall project through the sheet not less than three-quarters ($\frac{3}{4}$) of an inch and be located as shown and approved in design. All fusible plugs must be renewed at least once each year and examined at each washout.

Steam Gauge.

Every boiler shall be provided with a correct steam pressure gauge of proved reliable make, which shall be tested by the Inspector at the time of inspection, and must be set to correspond with a standard test gauge and placed so as to be plainly visible by the operator. Traction and portable boilers shall be provided with a steam gauge having double tube connections.

The dial of the steam gauge shall be graduated to not less than one and one-half times the maximum pressure carried on the boiler, and for dark hours be well lighted.

Syphon and Cut-out Cock.

All steam gauges shall be connected directly to the boiler and shall be fitted with a syphon or equivalent device sufficiently large, to fill the gauge tube with water, a cut-out cock with T or lever handle to be placed between the syphon and the boiler, to which it is to be directly coupled unconnected with any other fitting.

A ($\frac{1}{4}$ inch) one-quarter inch size, pipe connection must be provided on every boiler to permit Inspector's gauge to be connected above the cock on syphon pipe, for the purpose of testing in service the working steam gauge on boiler.

Gauge Glass.

Every boiler shall have at least one water glass not less than six inches (6) in length (as measured between the gland nuts), the visible bottom end of which shall be at least two (2) inches above the fire-line which in vertical unsubmerged tubesheet, firetube boilers shall be two-thirds the height of tubes, and for other boilers the highest point of crown sheet or fire-tube.

All water gauges must be capable of being operated from floor of boiler room or working platform of a traction engine or portable boiler, and in dark hours, be well lighted.

Gauge Cocks.

Every boiler shall have two (2) (and in boilers exceeding thirty inches in diameter three (3) gauge cocks, with three-quarter inch ($\frac{3}{4}$) pipe thread connections to boiler and minimum bore of three-eights ($\frac{3}{8}$) of an inch located within the range of the gauge glass, the lower cock to be placed in the same plane as the bottom of the glass. In traction or portable boilers the gauge cocks must be inserted within reach of operator in the face plate or in a water column attached to same. The cocks must be so made that the passage can be cleaned out without removing cock from boiler. In stationary boilers, where gauge cocks cannot be conveniently operated a second gauge glass may be used instead of gauge cocks, provided the second gauge glass is separately connected to the boiler.

Water Column and Connections.

The internal diameter of any water column and pipes attaching the same to the boiler shall be as follows.

Diameter of boiler.	Least internal diam. of pipe.	Least internal diam. of column.
Up to and including 36 in.	1 in.	2in.
Above 36 in. to 54 in.	$1\frac{1}{4}$in.	3in.
Above 54 in.	$1\frac{1}{2}$in.	3in.

Straightway stop valves or cocks of correct size are to be fitted top and bottom of the column. The fittings at the connections to boiler shall be as short as possible, and conveniently arranged with tees or crosses, having brass plugs for cleaning out. The waste pipe and valve at the bottom of the column shall be at least one-half the diameter of connecting pipes from boiler to column, and the end of the waste pipe plainly visible, so that the discharge may be noted.

Feed Water Supply.

Each boiler of fifteen (15) h.p. in capacity or over shall be equipped with two (2) separate means capable of supplying feed water, while the maximum steam pressure is carried on the boiler. Direct pressure to the boiler from a waterworks shall not be considered as one of the two means. A sufficient reserve supply of water for feeding boiler must, in all cases be provided for use with injectors or pumps.

Feed Arrangements.

(a) Each boiler shall have a feed pipe fitted with a check valve and also a stop valve between the check valve and the boiler. The feed water should be fed at the coolest part through an internal pipe where possible, but never near the parts of a boiler that are exposed to the direct heat of the fire or through the blow off connection—mud pans at water level at end of internal feed pipe are recommended, but they must not rest on the tubes.

Stop Valves on Steam Mains.

Each steam outlet for a boiler (except safety valve connections) must be fitted with a stop valve immediately at the boiler, in addition to the stop valve at engine. The use of angle valves at the end of a long steam main is not permissible.

Steam Mains.

Provision shall be made for the expansion and contraction of steam mains connected to all boilers with substantial anchorage at suitable points, to prevent perceptible vibration on the boiler shell plates.

Drains.

All steam mains shall be sufficiently drained. Where traps are connected to high-pressure drains the discharge end of trap shall be open for observation at all times. All drain cocks and valves must be accessible, and so placed as to render it practicable to drain any portion of the steam pipes or chests in connection therewith.

Blow-off Pipes and Valves.

Each boiler must be provided with a substantial blow-off pipe and straightway cock, the minimum diameter of which shall be one (1) inch and the maximum two and one-half ($2\frac{1}{2}$) inches. The pipe and cock must be adequately protected from the products of combustion. Globe or angle valves shall not be used for this purpose. Each blow-off pipe in a battery of boilers shall be connected independently to the drain, or open to the atmosphere.

The cock is to be connected to the boiler at the lowest point; if above one inch in diameter, a reinforcing plate is to be riveted to the shell of the boiler, and the blow-off pipe or cock attached to it. For externally fired boilers, such as return flue and return tubular, the blow-off connection must be made to the bottom of the shell, and to the mud drum or header for water tube boilers at the back end.

An opening in brick work for the blow-off pipe shall be fitted with an ample cast or wrought iron sleeve, to provide for free expansion or contraction. A bottom blow-off cock shall be protected by a guard or gland. The end of a plug shall be distinctly marked in line with its passage.

CATALOGUES.

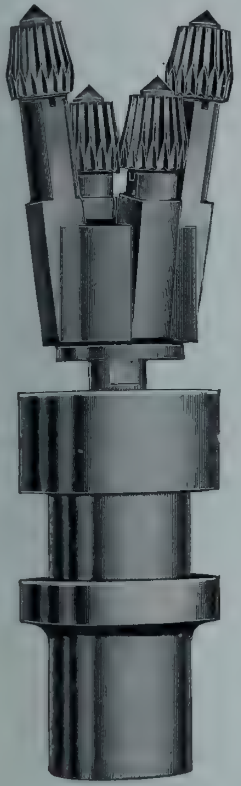
POWER PUMPS.—Among the styles of pumps described in catalogue 7 issued by the Smart-Turner Machine Co., Hamilton are single acting triplex and duplex power pumps, vacuum pumps, centrifugal pumps with motor, gasoline engine and belt drive, automatic feed pumps, vacuum pumps, etc.

POWER PLANT ECONOMICS FOR 1910.—Is the title of a 16 page catalogue from The Power Economy Co., Montreal, showing their lines of power plant specialties. The list includes the "F. & W." metallic packing the "Crescent" patent grate bar, and the "Economic" steam blower for forced draft. Copies will be sent on request.

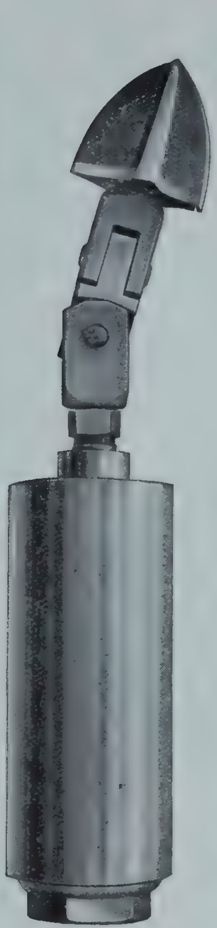
GAS ENGINES.—A neat catalogue issued by the Dubois Iron Works, Dubois, Pa., describes their single cylinder, tandem and twin tandem engines arranged to operate on natural, illuminating and producer gas. The various parts are taken up in detail.

Wm. B. Scaife & Sons Co., 221 First Avenue, Pittsburg, have issued several interesting publications one being a paper "Scaling and Corroding Substances and their Elimination from water for Boilers," and another "Feed Water Heaters as Purifiers," both by J. C. Wm. Greth. These are excellent treatises on these subjects. A catalogue issued by the Wm. B. Scaife & Sons Co., describes fully the system of water softening and purification.

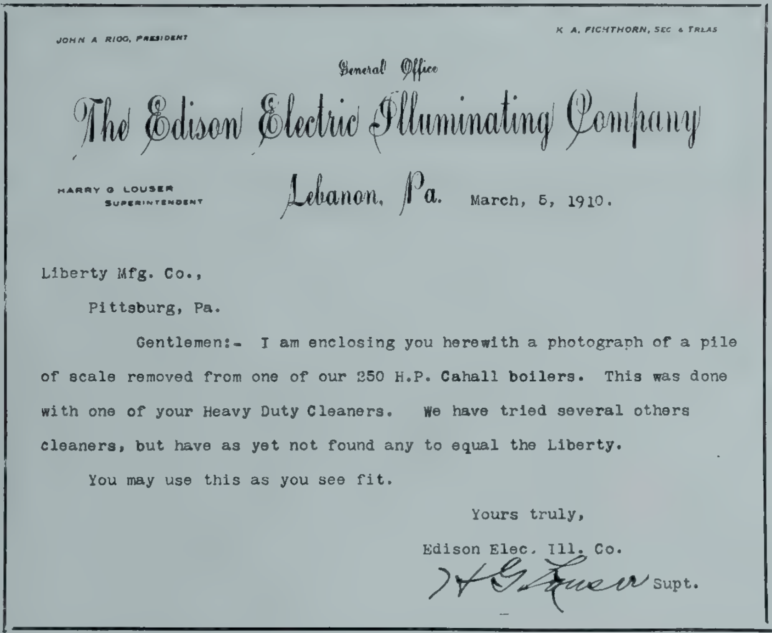
HEATER AND CONDENSER.—Heating and drying with exhaust steam and production of vacuum without the expense of water is explained in a pamphlet issued by the Hudson Economizer Co., Gloucester House, 2 Bishopsgate St. Without, London, E.C., England. Their patent air heater and condenser is also illustrated and described.



"CYCLONE" CLEANER



"HEAVY DUTY" CLEANER



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The Edison Electric Illuminating Company

HARRY G LOUSER
SUPERINTENDENT

Lebanon, Pa. March, 5, 1910.

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Pittsburg, Pa.

Gentlemen:- I am enclosing you herewith a photograph of a pile of scale removed from one of our 250 H.P. Cahall boilers. This was done with one of your Heavy Duty Cleaners. We have tried several others cleaners, but have as yet not found any to equal the Liberty.

You may use this as you see fit.

Yours truly,

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The above is an unsolicited endorsement of the good work of one of our

Heavy Duty Cleaners

Think of the unnecessary fuel this boiler must have consumed and its cost. Then compare this cost with the cost of the Cleaner.

Does it pay to try to make steam through this heavy coat of scale? Order one of our many types of Cleaners at our expense. If it fails to make good, return it. Don't forget we have as low-priced machines as our competitors and are prepared to meet all requirements for Cleaners for Water Tube Boilers.

Write us to-day for catalogue describing our different power plant accessories.

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POWER PLANTS DEVELOPMENTS.

Alberta.

EDMONTON.—A half-million dollar packing plant is to be erected here during the forthcoming season by P. Burns & Co., of Calgary.

CALGARY.—The commissioners have recommended that a by-law to raise $125,000 for the proposed municipal electric power plant, be submitted to the ratepayers. City Engineer Childs has completed plans. An estimate of the amount that will be required for electric light extensions has just been prepared by Commissioner Graves, and includes : 86,071 pounds weatherproof wire at 18 and 20 cents, $15,593.32 ; 550 poles, various sizes, $2,169 ; 2,600 cross arms, various sizes, $920 ; machine and carriage bolts, washers, wood screws, nails, guy wire and clamps, cross arm braces, fuse wire and plugs, rubber-covered wire, porcelain tubes, top pins, D. P. insulator, lamp sockets, pole steps, sundries, $5,621.27 ; meters, various sizes, 12,000 ; transformers, various sizes, $10,280 ; 100 arc lamps and station transformers and equipment, $7,000. Total $70,000.

Manitoba.

WINNIPEG.—An abattoir bill has been introduced and is being favorably considered in the [illegible] of Manitoba. It provides for an appropriation of not to exceed $50,000 "for the purpose of acquiring a site for and assisting in establishing, equipping, operating and maintaining thereon, a public market and a public abattoir for the slaughter of cattle and other live stock, together with a suitable cold storage plant." The bill provides also for the appointment of a "Board of Abattoir Commissioners" not to exceed three members, and for government agreement with cities where it is proposed to establish public abattoirs and markets.

WINNIPEG.—The A. MacDonald Co. has arranged for the construction of a cold storage warehouse, 50 x 100 feet, five stories high, on Market Street. A smaller cold storage warehouse is also to be erected by the company, it is stated at Lethbridge.

WINNIPEG.—The Manitoba Cold Storage Co., S. H. MacColl, manager, have secured a site on Higgins Avenue, between Argyle and Maple Streets, where they will build a 6-story cold storage warehouse to cost about $80,000. The equipment, it is stated, will include a modern refrigerating plant.

BRANDON.—Engineer Speakman has prepared plans for the establishment of a steam generating plant, capable of furnishing sufficient power to operate a street railway, the pumping station and street lighting, and save about 300 horse power in reserve. A public steam heating system would also be served. Estimated cost $125,000.

BRANDON.—The Brandon Electric Light Co. is considering the question of increasing the capacity of its plant by the installation of a 1,000 k.w. steam turbine and generator.

Ontario.

LONDON.—The contracts for the equipment of the pumphouse at London were awarded to the following : turbine pumps, J. McDougall & Co., Montreal, $5,640 ; motors, dynamos, etc., Lancashire Dynamo and Motor Co., Manchester, England, $11,032 ; compressors and gas engines, G. H. & H. J. Daniels, Stroud, England.

PETERBORO.—As stated in a previous issue of The Power House, the Canadian General Electric will enlarge their Peterboro plant. The company will spend $250,000 and will erect a power house at the Peterboro waterworks dam, paying the city $2,000 a year.

PRESCOTT.—This municipality will shortly invite tenders for the extension of their sewerage system, including one septic tank. A by-law to raise $22,000 for this purpose has been carried.

ST. THOMAS.—Contract for installing a booster and additional cells in the present storage battery, as well as overhauling the battery for the Niagara power system, has been awarded to the Lancashire Dynamo Co., 152 Bay St., Toronto, at $3,499. Contracts for cross arms and pins were awarded to F. Bissell & Co., Toledo, and for braces to the Canadian General Electric Co.

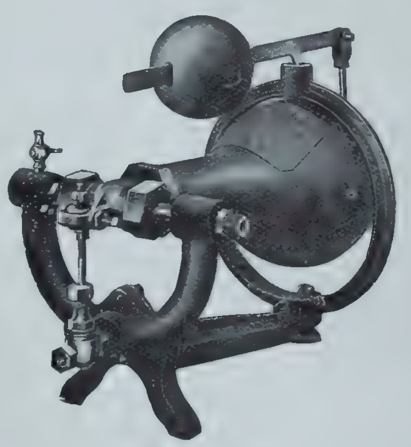
RENFREW.—In order to raise money for the development of the water powers, a by-law will be submitted to the ratepayers for $77,000.

OTTAWA.—Gas and Electric Appliances, Limited, has been incorporated, capital $50,000. Incorporators, Herman Henry Pitts, manufacturer, and Gordon McLeod Pitts, civil engineer, both of Montreal, Que.

MIDLAND.—In addition to the contract let to the Wm. Hamilton Co., noted in last issue, for 5 turbines, etc., contracts have also been awarded as follows :—Two 200 h.p. exciter turbines, William Hamilton Co., of the Leffel design ; two feed pipes with the regulating stand pipes, Wm. Hamilton Co. All the electrical machinery, Canadian Westinghouse Co., covering up to five 900 k.v.a. generators and two 100 k.w. exciters with transformers, switching and lighting arrestor equipments for both the Big Chute and Midland stations. Line wire, Northern Aluminum Co. ; insulators, Pittsburg High Voltage Insulator Co. Pratt & McDougall, of Midland, have the general construction well under way. It is also announced on good authority that the Simcoe Railway & Power Co., for whom this construction is being done, will construct an electric railroad to serve this district. Mitchell & Mitchell, consulting engineers, Traders Bank Building, Toronto.

TORONTO.—The Canadian General Electric Co. have closed a number of large contracts, including one from the Electrical Development Co., Niagara Falls, for three enormous generators of 15,000 h.p. each. Another contract of equal importance has been entered into with the Ontario Power Co. for the supply of three units,

BUNDY Trap Economies
Quickly Noticed



BUNDY Traps and Separators are economical and positive, and never allow a pound of condensation to escape. BUNDY Traps can be used successfully as a boiler feeder, the Trap being placed three or more feet above the water line in the boiler, and the feed water temperature shall not be less than 100 degrees F.

BUNDY TRAP

BUNDY TRAP AND SEPARATOR

economies are quickly noticed, almost from the moment of installation.

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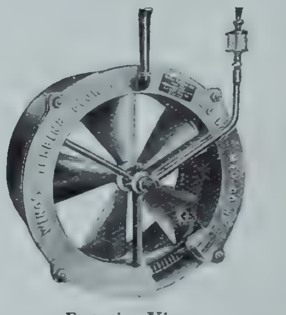
For Forced Draft



Exterior View

Interior View

A combination of two well-known machines, **Wing's Disc Fans or Blowers** and a simple, practical, **Turbine Engine.** The engine consists of a series of buckets or vanes fastened to the outer ends of the Fans or Blower Blades to receive the impulse of steam, and three or more nozzles from which the steam impinges on the turbine buckets that are especially designed to get the highest possible value of the expansion of steam, and thus give a positive and economical power to drive the Blower.

For Forced Draft the small amount of steam that drives the Blower, passes in under the grate with the air, thoroughly mixed, and gives the most perfect combustion ever obtained by any mechanical or natural draft system.

Each boiler has its individual Turbine Blower, which is placed in the side or in the rear wall, as shown in illustrations.

The price of the Blower is moderate and the cost of installation small, while the saving in fuel is greater than by any other system.

The Blowers are strong, well built and require no further attention than to see to the lubrication.

The system when installed complete is absolutely automatic in operation.

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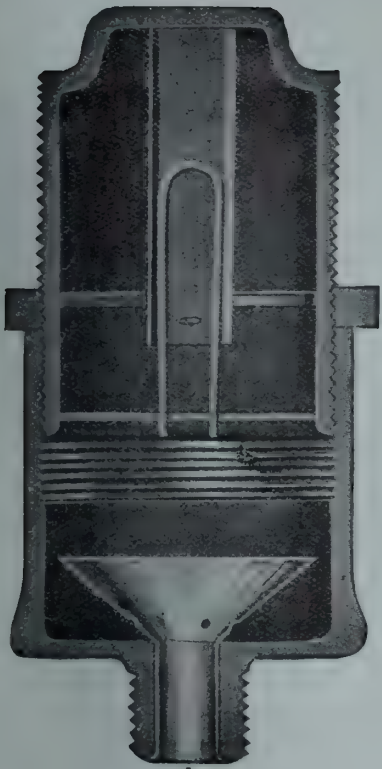

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The Right way to lubricate is by Natural Pressure, the Principle employed in the

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It is entirely free from friction. No piston or spring is used, just a thin metal disc resting lightly on the grease to keep it level. Air pressure above and the needs of the journal below are all that is required to give perfect lubrication. Grease does not change in any way while in the Philadelphia Cup ; the last drop is as good as the first. There is a large unrestricted outlet and a regularity of action which permits perfect feeding of grease of any thickness.

We guarantee that the Philadelphia Grease Cup will give absolute satisfaction and save at least 50% over any other system. Moreover, you'll find it cheaper in first cost. Our booklet tells about it. A copy free on request.

Peterborough Lubricator Mfg. Co.
LIMITED

Head Office and Factory : Peterborough, Ont.

each of 12,500 h.p. capacity. Another contract with the Western Canada Power Co., who are installing a large plant at Stave Lake, near Vancouver, B.C., calls for two 10,000 h.p. units. These three orders alone make up a total of over 100,000 h.p.

TORONTO.—Included in the supplementary estimates of the Provincial Treasurer are the following items: Electric plant, Hamilton Asylum, $12,000; electric plant, London Asylum, $25,000; electric plant, Ontario Agricultural College, Guelph, $15,000

CAMPBELLFORD.—The Seymour Power Co., by agreement with Welland, will install another unit of 1,000 k.w. capacity to supply the town's needs for light and power.

ST. THOMAS.—This city will install 650 tungsten street lamps in the near future.

WALKERVILLE.—The Canadian Hoskins, Ltd., has been incorporated with a capital of $40,000 to manufacture and deal in electric furnaces, electrical machinery, etc. Those interested are: J. H., H. E. and H. H. Walker, of Walkerville, A. L. Marsh and W. W. Tolman, of the Hoskins Mfg. Co., 451 Lawton Ave., Detroit.

STRATFORD.—A by-law to raise $85,000 for a distribution plant for Hydro-Electric power was carried on April 14.

HAMILTON.—The by-law to issue debentures to the amount of $100,000 for extending and improving waterworks has been passed by the council.

PETERBOROUGH.—Ald. Hicks, chairman Board of Works, has been authorized to have an estimate made of the cost of the proposed sewer pumping station, the relaying of Romains Street sewer, the required surface drainage and also of the septic tank. Consulting engineer, Willis Chipman, C.E., Toronto.

TORONTO.—The Canada Foundry Company have organized a department of field erection, of which Mr. J. J. Scollan has been appointed superintendent.

Nova Scotia.

WOOD'S HARBOR.—According to United States consular reports parties from Boston, Mass., are arranging to establish a cold storage warehouse at Wood's Harbor, to be used largely for storage of bait for fishermen. They will apply for the subsidy offered by the Dominion government for such enterprises.

DARTMOUTH.—The Christie Fish Co. contemplates building a cold storage warehouse for its own and the public's service and has applied for the government bonus under the subsidy act.

LOCKPORT.—The Maritime Cold Storage Co. has decided to erect a 5-story cold storage warehouse, to cost not less than $85,000, after plans approved by the Dominion government, so as to secure the 30 per cent. bonus under the act to assist cold storage.

Prince Edward Island.

CHARLOTTETOWN.—The Island Cold Storage Co., the corporation formed by Davis & Fraser, who succeeded the old Dominion Packing Co., contemplates building extensive cold stores, which are required in its business of handling meat and provisions, and which they intend to make large enough to provide public cold storage facilities and thus obtain the government bonus for establishing cold storage plants.

In New Offices.

C. W Bongard Co., manufacturers and dealers in electrical supplies, are now located at 70 King Street West, Toronto. They have not only larger quarters but an increase in the office and sales staff of the company. C. W. Bongard is president, Frank Scofield general manager, C. H. L. Keeler sales manager, and J. A. Johnston, assistant sales manager.

Canadian Boving Co.

The Canadian Boving Co., Ltd., are now to be found at their permanent office, 164 Bay Street, Toronto, where they will carry on the well established business of water and general power engineers, which was originally started in this country by Jens Orten-Boving, of London, England, whose name is well known in all matters relating to water power plant.

Mr. A. Aeberli, who has joined the company as chief hydraulic engineer, has a very wide experience of European and American practice in this branch of engineering, and is already well known on this Continent.

Amongst the contracts now in hand in this country, the following are worthy of note, and as the machines for Calgary and Winnipeg are well advanced, engineers will shortly have an opportunity of seeing for themselves the excellent workmanship and design for which the new company are responsible. Winnipeg City, five wheels, each of 5,300 h.p. two wheels each of 500 h.p. with governors complete; Calgary Power Co., one wheel of 6,000 h.p. two of 3,750 h.p. each, and two of 350 h.p. each; Toronto City, four turbine pumps, capacity 16,000,000 gallons per day each, and four of 13,500,000 gallons; Cobalt, complete governor gear for four sets of wheels of 2,750 h.p. each; Jordan River, large pipe line contract.

The firm are also prepared to contract for work of the following description and will be pleased to submit tenders or to give information on any of the subject mentioned, viz: complete steam power equipments, steam condensing plant of all types, Diesel crude oil engines, high and low lift centrifugal pumps, pipe lines, pulp and paper making machinery, flexible couplings, tachometers, electric furnaces for steel refining and direct ore reduction.

A very interesting, and complete treatise on water power plant is being prepared, which will be sold at a small cost, as it has involved considerable expense in preparation. It will however be invaluable to engineers dealing with such matters.

Toronto Offices of Packard Electric Co.

The Packard Electric Co. have established general sales offices in the Saturday Night Building, Toronto, in charge of their sales manager, Geo. C. Rough. W. R. Christie will be attached to this office and will cover the Ontario district on the road.

1910 Calendars.

Allis-Chalmers-Bullock, Montreal, manufacturers of hydro-electric plants, etc., have issued a 1910 edition of their "First Engineers" calendar which received so much favorable comment a year ago. This calendar shows two beavers at work, the picture being appropriately named "The First Engineers."

The calendar issued by the Dearborn Drug & Chemical Works, 225 Postal Telegraph Bldg., is printed in large figures that may be seen across the power plant. The Dearborn company are manufacturing and analytical chemists, their specialty being feed water treatment.

The Gutta Percha & Rubber Mfg. Co., Toronto, manufacturers of rubber hose for all purposes, belting, valves, packing, gaskets, etc., have issued a calendar printed in large figures making a very useful calendar. It is surmounted by a large gold Maltese cross, the trade mark of the company.

The Hamilton Engine & Packing Co., Hamilton, dealers in Clappison's ring and spiral engine and pump packing, asbestos and mineral wool pipe and boiler coverings have issued a calendar for 1910 reminding the recipients of the lines carried by this company.

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No strings on this.

The pamphlet is *free* to every salesman.

All you need do is to write us, stating your name, your private address and the name of the house you represent.

We want these particulars simply by way of proof that you are a traveling salesman because we charge non-salesmen 50c a copy for the pamphlet—and it's well worth it, too! But, remember, it is *perfectly free* to traveling salesmen.

Better write for *your* copy now.

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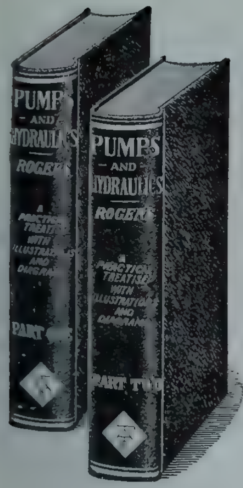

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¶ These two volumes written so you can understand contain practical information on the construction, care and management of all types of **Pumps and Pumping Machinery,** also explaining the complete science of hydraulics and hydraulic machinery.

¶ Gives full instructions in valve setting and also a mine of up-to-date valuable information for engineers, superintendents, firemen and all men in charge of Power Plants.

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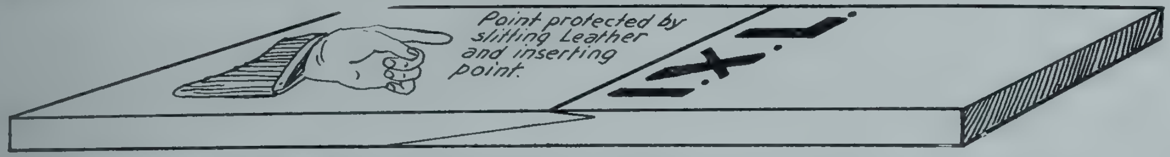

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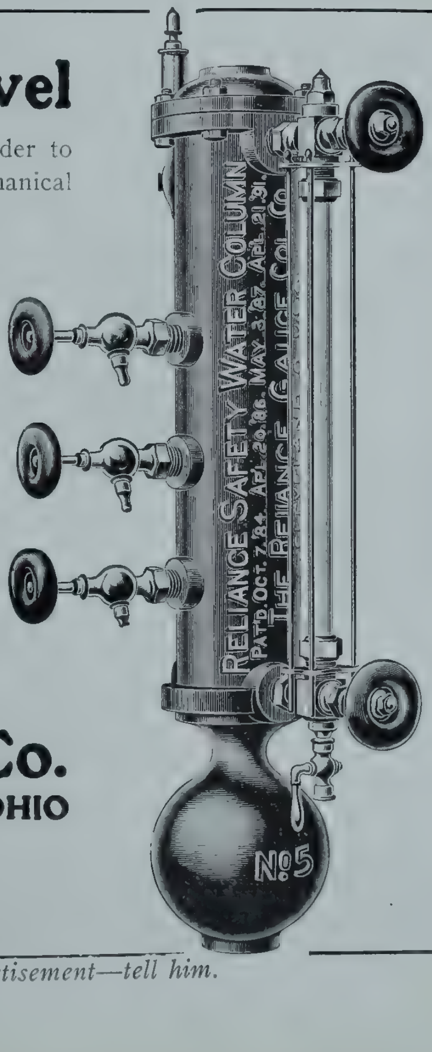
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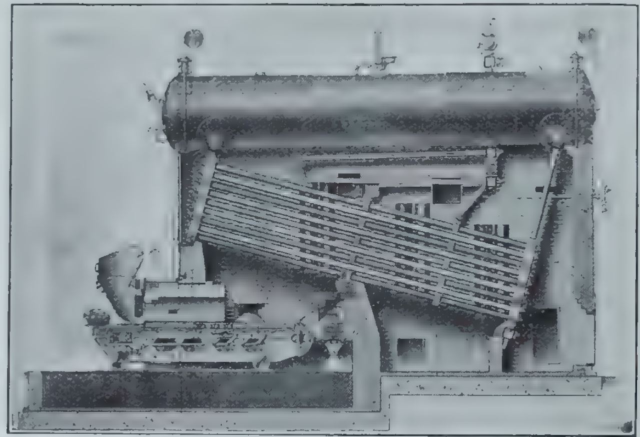

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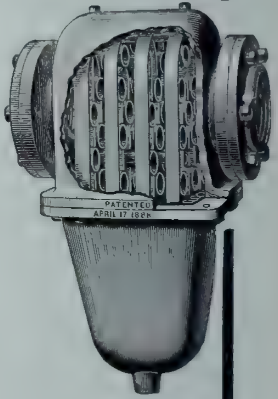

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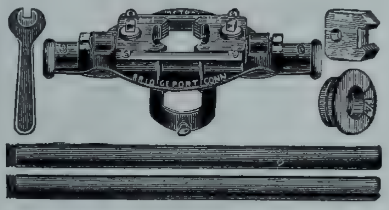

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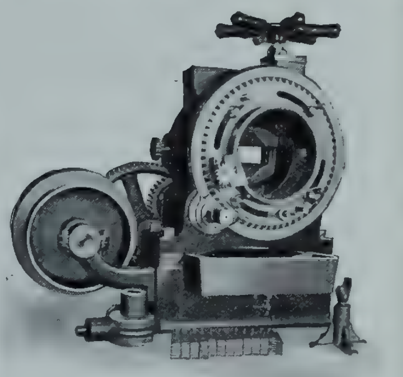

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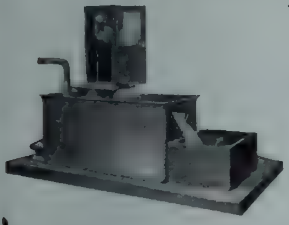

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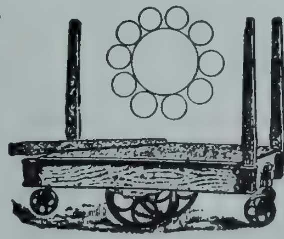

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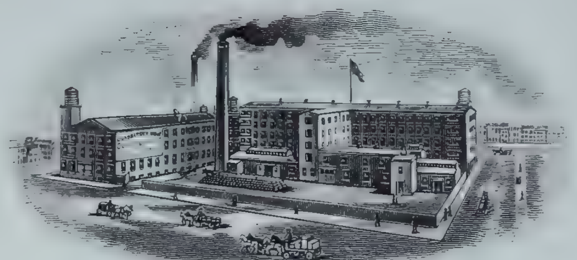

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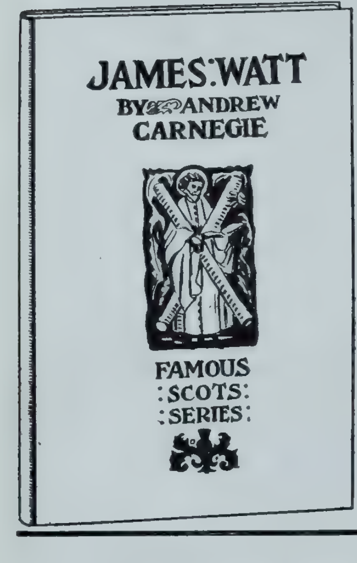

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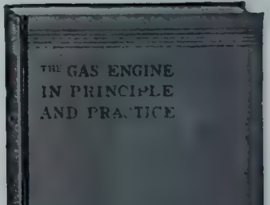

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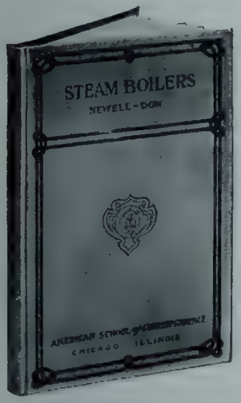

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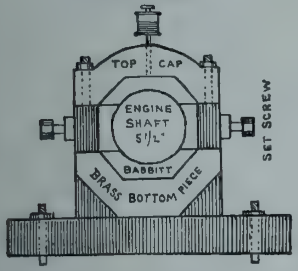

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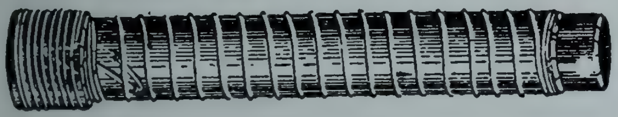

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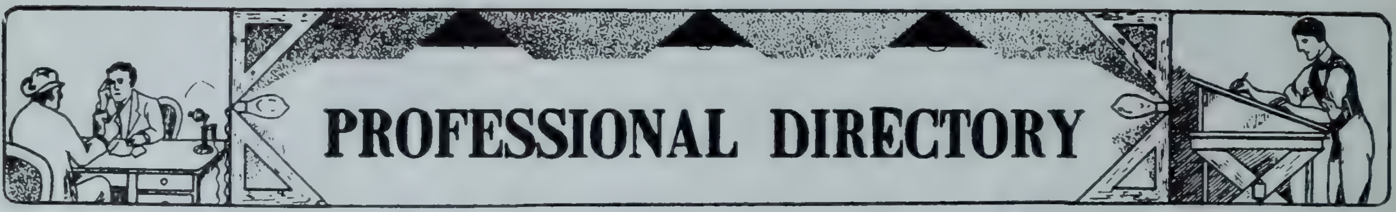

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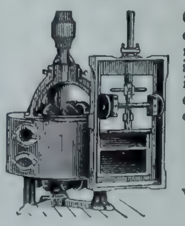

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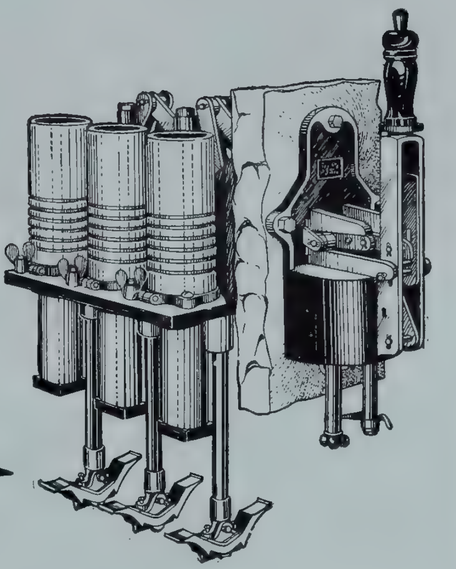

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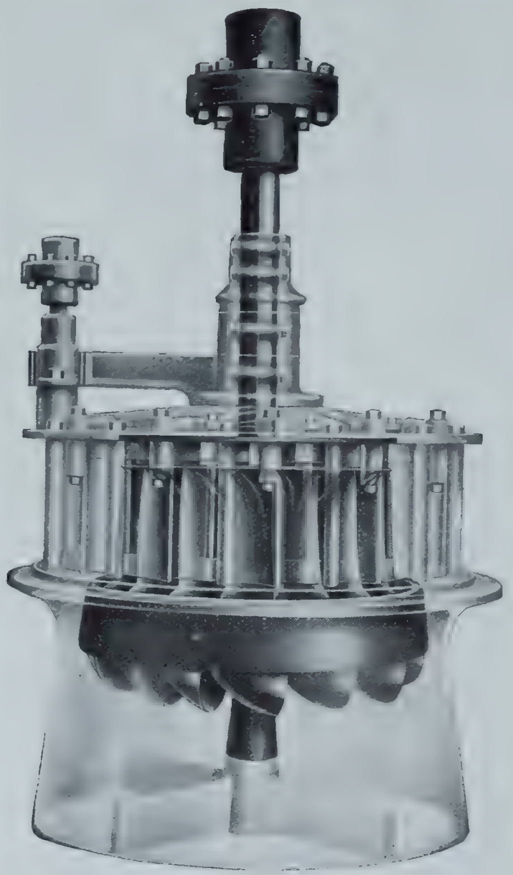

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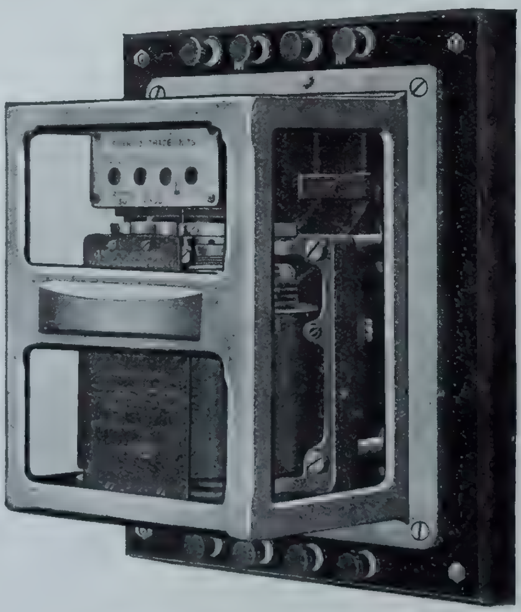

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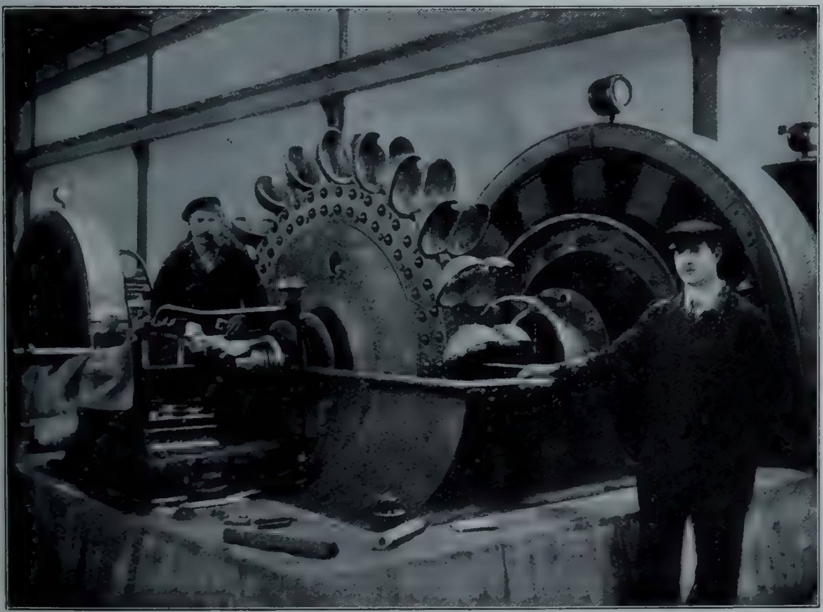

LOCHLEVEN, Scotland 30,000 PS.

SPECIALITIES:

WATER TURBINES built for any unit from 1/4 to 16,000 PS. and for any Head from 3 to 3,000 feet.

HIGH PRESSURE PIPE LINES

STEAM TURBINES

CENTRIFUGAL PUMPS

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109, Victoria Street, S.W.
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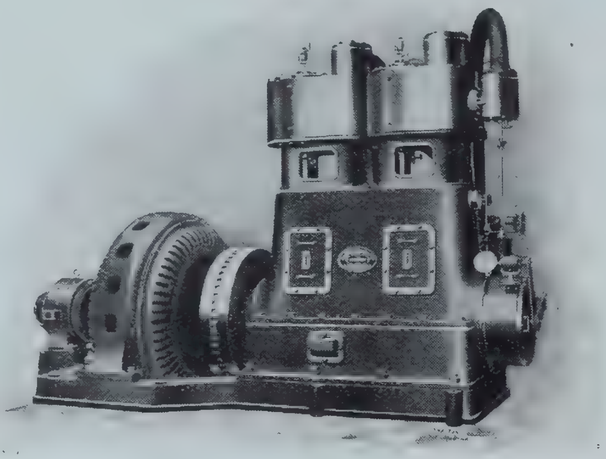
Contracting Engineers - Dineen Building, Toronto



BRUCE PEEBLES
DIRECT CONNECTED ALTERNATOR

Representatives in Canada for

Evershed & Vignoles, Limited
London, England
Electrical Instruments of all kinds, Meggers & Bridge-meggers

Reavell & Co., Limited
Ipswich, England
Air Compressors, etc.

Bruce Peebles & Co, Limited
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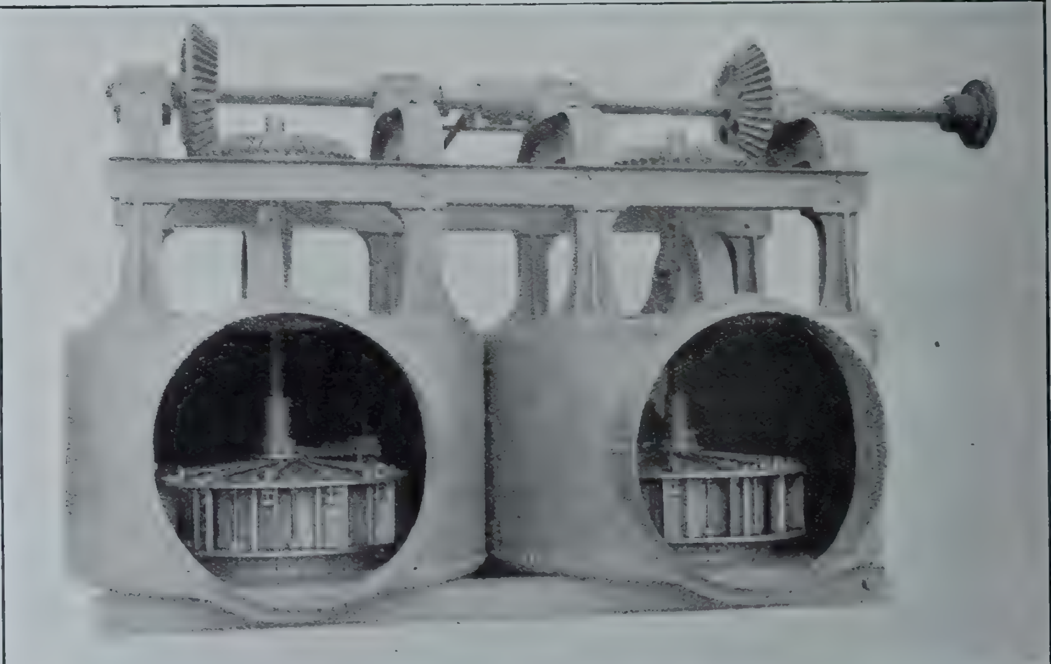
Direct and Alternating Current Dynamos and Motors, Steam Turbo Alternators, etc.

Berry, Skinner & Co., Limited
London, England
Fool proof Switch Gear.

Unbreakable Pulley & Mill Gearing Co., Limited
Friction Clutches and Mill Appliances.

Venner's Time Switches, ***Morganite*** Brushes, ***Battersea*** Carbon, ***Bullevant's*** Cables, etc , etc.



WATER POWER is Cheap and Reliable!

Even though it may be only a small stream that runs through your property you can harness the water most effectively by installing a

"TRIUMPH" TURBINE

No other Turbine will stand as much rough usage as the "Triumph," which is guaranteed to develop more power for its size than any other wheel on the market.

The "Triumph" Turbine has a tight-fitting, easy-working gate, operated by governor, which gives the wheel an unusually steady motion. It will be found to give larger efficiency at all stages of gate opening than any other Turbine.

Send for our illustrated booklet, whether you are an immediate buyer or not. Askfor booklet P.H.

The MADISON WILLIAMS MFG. CO., Limited. - - LINDSAY, ONT.

WATER POWER PLANTS

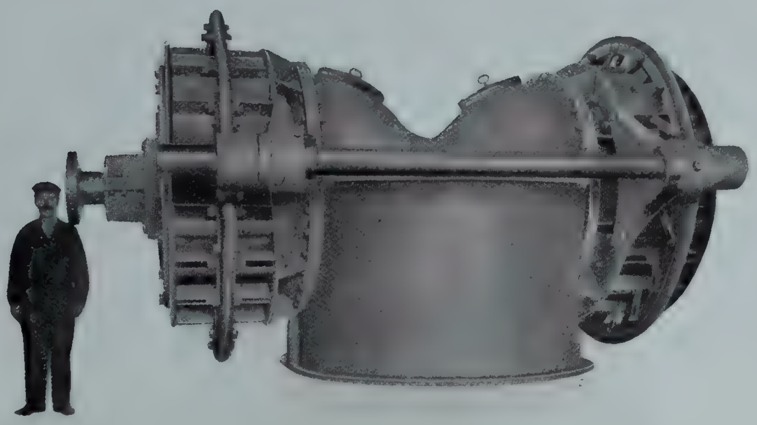
All Sizes

FRANCIS TURBINES
IMPULSE WHEELS

Any Head

Highest Speed, Highest Efficiency, Greatest Power

(Testing Flume, at our works)



5000 h.p., 250 r.p.m., 73-ft. head, double turbine

Centrifugal Pumps

High and low lift. Automatic water balanced thrust. No pressure stuffing boxes. Highest efficiency guaranteed.

Water Turbine Governors

New vertical double compensation type, giving closest regulation and constant speed.

Paper and Pulp Making Machinery

Pipe Lines

Flexible couplings. Tachometers.

Electric Furnaces

For iron ore reducing and steel refining.
(2-phase system).

Diesel Oil Engines
High or low speed.

Steam Condensers
All types and capacity.

TELEPHONE MAIN 7389

The Canadian Boving Company

HEAD OFFICE:
164 Bay St., Toronto

BRANCH OFFICE:
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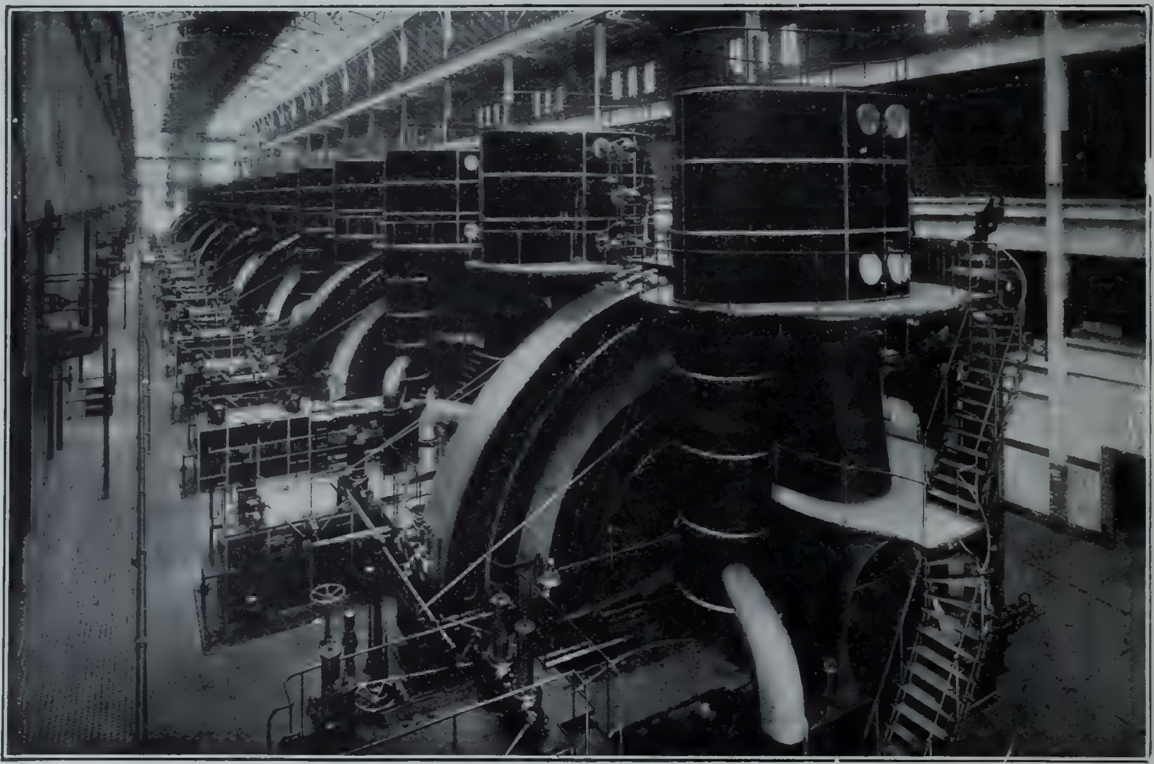


Eight Westinghouse 5000 K.W., 1100-Volt, Three-Phase Engine-Type Alternators.

Westinghouse Alternators

The Westinghouse Company introduced the alternating current system into America in 1886, and since that date has led in the development of alternating-current generators, motors and auxiliary apparatus. : : : :

SEND FOR CIRCULAR No. 1133

Canadian Westinghouse Co., Ltd.,
General Offices : Hamilton, Canada

SALES OFFICES:

Traders Bank Building, **TORONTO**
232 St. James Street, **MONTREAL**
92 Hollis Street, **HALIFAX**
Portage Ave. East. **WINNIPEG**
8th Street West, **CALGARY**
439 Pender Street, **VANCOUVER**

To the **Central Station Engineers** of Canada

A number of Central Stations have already requested our services for their *annual Fall preparation* for the heavy winter load, but there are a number of you from whom we have not heard.

We wish to thank those of you who have favored us with orders and also to assure the hesitant ones that their work will receive the same *careful and prompt attention* which has made our old customers our good business friends.

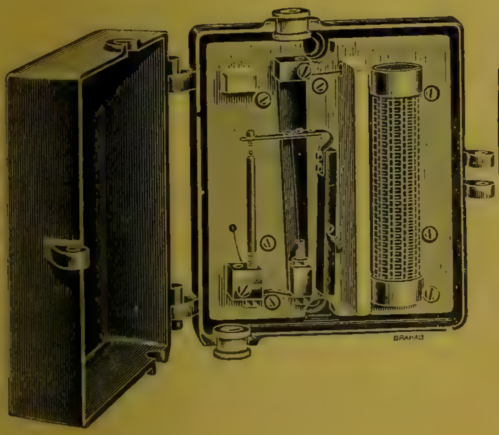
When sending in your work, we would be pleased to have your suggestions for changes your daily observation of the machine has shown necessary.

REMEMBER

The Electrical Maintenance & Repairs Co.

162 Adelaide Street West, TORONTO
Phone Main 3419

The Specialists in the Cure of Electrical Diseases.



PROTECTION

For Electric Lighting Companies

The N.C.S. THERMAL LIMITER

(PATENT)

protects the company in all cases where light is paid for on the flat rate system. It warns the consumer when he is exceeding his contract and also makes it impossible for him to continue to use light until he has reduced the demand to the agreed limit.

The ***N.C.S.*** Thermal Limiter consists of two bars with a wire attached to a spring contact; the bars are of iron, as is also the wire; this arrangement ensuring absolute compensation for any changes of temperature. It is free from self induction, and equally suitable for Direct Current or Alternating Current circuits.

The whole apparatus is mounted on a china base and enclosed in a cast-iron case, and is so arranged hat it can be sealed. It can also be used in conjunction with a fuse box.

THE WAY IT WORKS

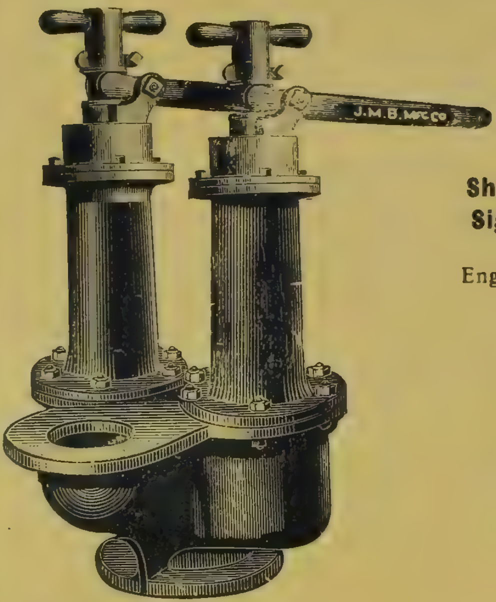
is as follows :--When the candle power is exceeded by switching on an additional lamp, the extra current will cause the wire to expand and open the contact at the extremity of the spring. This puts a resistance into the circuit, thus dimming the lamps, and at the same time the wire cools, and closes the contact again ; and thus the cycle of operations is repeated. This produces continual flickering of the lights, which will cease as soon as the additional lamp is switched off. A condenser is arranged across the gap to prevent any sparking which might otherwise ensue.

CHAPMAN & WALKER, Limited

69 Victoria Street, - - - - TORONTO, ONT.

MARINE SUPPLIES

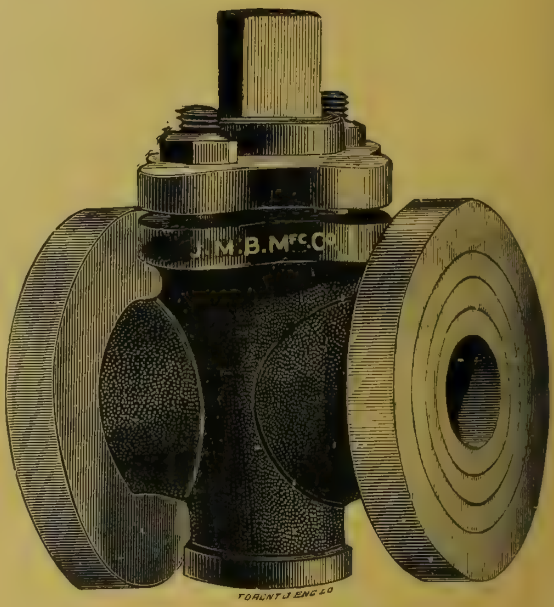
For the Engine and Boiler Room



Marine Pop Safety Valves

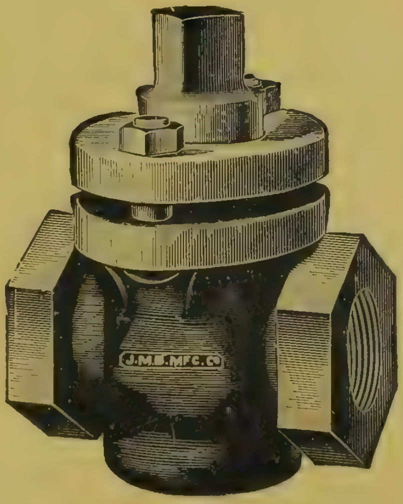
Single and Twin Type
made in
Accordance with Government
Inspection Regulations.

**Ship, Telegraph or
Signal Apparatus**
with
Engine Room Indicator



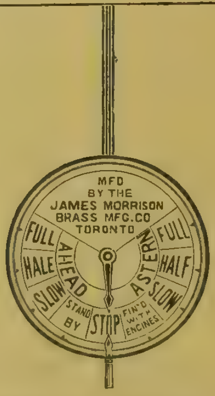
Standard Marine Brass Stop Cocks

Flanged Top, with Packing Gland and Solid Base, Made Screwed both ends—Flanged and Screwed, and Flanged both ends, ¾ inch to 3 inch.



Asbestos-Packed

Brass and Iron Stop Cocks
Screwed and Flanged Patterns.



**Made for Single or
Twin Screw Steamers**

on Polished Brass Pedestal
also
in small pattern for
Yachts and Launches.

J.M.T. Y Blow-off Valve

Double extra heavy for high pressure with renewable Seat and renewable disc.

The James Morrison Brass Mfg. Co., Limited

93-97 Adelaide St. West, TORONTO

The advertiser would like to know where you saw his advertisement—tell him.

CIRCULATES IN EVERY PROVINCE OF CANADA

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
Published by The MacLean Publishing Co., Limited.

MONTREAL: Eastern Townships Bank Bldg. TORONTO: 10 Front St. E. WINNIPEG: 511 Union Bank Bldg. LONDON, ENG.: 88 Fleet St. E.C

Vol. III. Publication Office, Toronto—May, 1910 No. 5

PENBERTHY TRADE MARK

THE

K-I-N-G

PENBERTHY TRADE MARK

Sight Feed Lubricator

Specially designed for Threshing and Portable Engines, Steam Pumps, Saw Mill and Hoisting Engines, etc.

A neat, compact, simple and reliable Lubricator at a moderate price.

Easy to attach—Easy to operate

Simple in construction—Reliable in action

The King is the best medium-priced Lubricator on the market to-day.

It is made of best steam metal, is carefully assembled, and thoroughly tested before it is sent out.

The sight feed glass which is located at the top of the Cup enables the oil feed to be easily seen from a distance. The sight feed is an up-oil-drop the same as found on the more expensive Lubricators.

The glass will not break easily and can be quickly removed by simply unscrewing the cap at the top of the sight feed chamber.

The filler plug and drain valve are attached to the cup and cannot become lost.

Write for descriptive circular to-day. You owe it to yourself to look into the merits of this Lubricator.

Engineers Operating Stationary and the Higher Grades of Engines Should ask for the Peerless Sight Feed Lubricator.

Strictly High Grade and Thoroughly Reliable

Send for Descriptive Circular

Penberthy Injector Co., Limited, - Windsor, Ont.

Condensing Apparatus

The Condenser until recently has received far less consideration than the steam engine, but the advent of the steam turbine and the demand for higher economy have compelled the recognition of the condensing apparatus as one of the principal parts of a steam plant.

Condenser at Canadian Car and Foundry Co.,
Blue Bonnets Plant

Advantages of Condensers

1. Power is increased with the same fuel consumption.
2. Fuel is saved with same output of power.
3. Boiler feed water is saved in proportion to saving of fuel.
4. Boiler feed water is freed from lime and other scaling qualities.
5. Noise of escaping exhaust steam is stopped.
6. Boiler pressure may be lowered 10 to 20 lbs. without reducing power economy.
7. Number of boilers necessary for a given power may be reduced.

Descriptive Bulletins will be sent on application to our nearest sales office.

The John McDougall
Caledonian Iron Works Co., Limited

WORKS——MONTREAL

Sales Offices :— Montreal Toronto Cobalt Winnipeg
Calgary Vancouver

WE BUILD

BOILERS

ALL TYPES AND SIZES

¶ Our line of Portable, Stationary and Marine Boilers is well known. Every Boiler we turn out is built right. Our materials are the best, designs are modern and up-to-date in every way, the workmanship is perfect. All work is carefully and rigidly inspected before leaving the shop.

SEND US YOUR ENQUIRIES

WE WILL BE PLEASED TO QUOTE ON YOUR SPECIFICATIONS

The WATEROUS ENGINE WORKS CO., Limited

BRANTFORD, CANADA

Horizontal Return Tubular BOILERS

"Inglis" Boilers are noted for

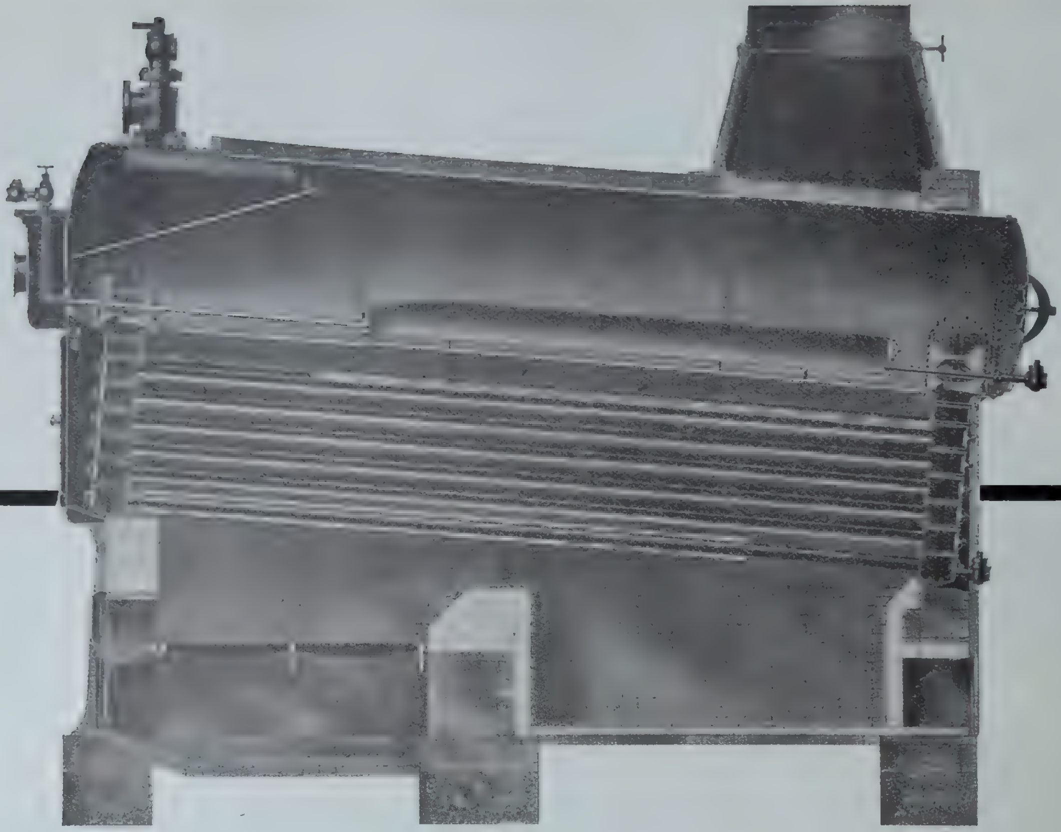
Quality **Capacity** **Economy**

Specifications and Prices on Request

The John Inglis Company, Limited

ENGINEERS AND BOILER MAKERS

14 Strachan Avenue, - - Toronto, Canada



An Ideal Boiler!

For any purpose for which high pressure steam is required, we claim that the most efficient and satisfactory boiler is the

Heine Safety Boiler

It is a an ideal boiler, because it fulfills the four cardinal conditions which are demanded by the best practice. Here are four leading features :—

The ***Heine Boiler*** is economical in fuel, because it will deliver the greatest quantity of dry steam for each pound of fuel burnt. It is safe and durable, every known test being applied to insure its safety and only the best material being used. It is also economical in floor space, and is easily accessible in every part for cleaning.

Thousands of boilers in use in the world's largest plants.

Write for our literature; it cannot fail to interest you.

Agents for Province of Quebec : WATSON JACK & CO., 709 Power Bldg., MONTREAL

POLSON IRON WORKS, Limited
TORONTO

Horizontal Tubular Boilers

Our Horizontal Tubular Boilers are carefully designed, and the materials used in their construction the best obtainable of their respective kinds.

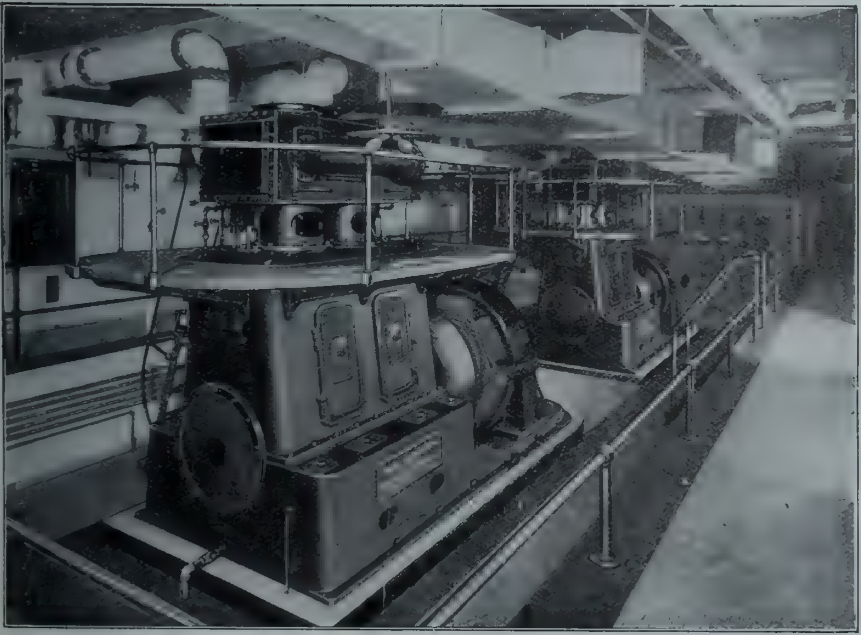
Can We Mail You Catalog?

Write Nearest Sales Office.

We Contract for Complete Steam Power Plants, Engines included.

THE JENCKES MACHINE COMPANY, Limited

GENERAL OFFICES: Sherbrooke, Quebec WORKS: Sherbrooke, Quebec; St. Catharines, Ontario
SALES OFFICES: Sherbrooke, St. Catharines, Cobalt, Vancouver, Montreal, Rossland



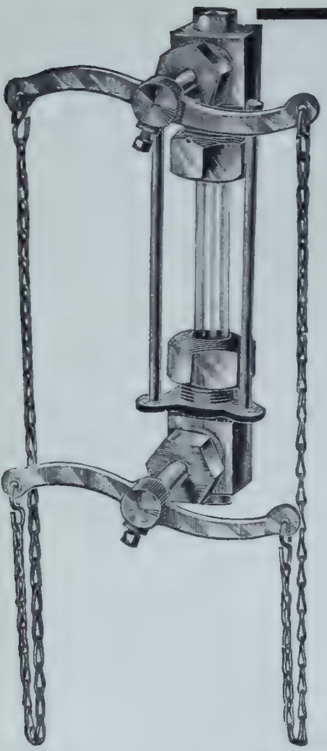
Has Cost Nothing for Repairs

A customer says:—

"We have used one of your vertical high speed engines, English type, forced lubrication, since 1907. The engine runs at 425 revolutions per minute almost constantly night and day. It has given us every satisfaction and so far has cost us nothing for repairs."

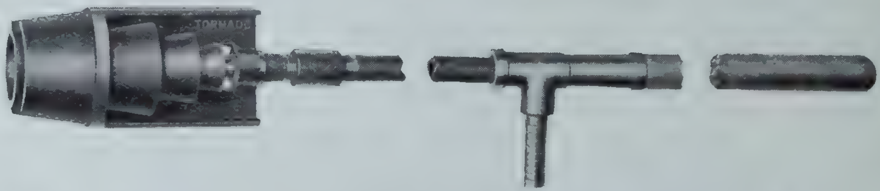
Robb Engineering Co., Ltd., Amherst, N.S.

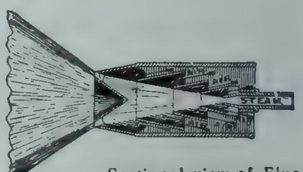
DISTRICT OFFICES:
607 Canadian Express Building, MONTREAL; R. W. Robb, Manager
Traders Bank Building, TORONTO; Wm. McKay, Manager
Union Bank Building, WINNIPEG; W. F. Porter, Manager
609 Grain Exchange Bldg., CALGARY; J. F. Porter, Manager



If You Desire To Save Troubles In Your Boiler Room—Use

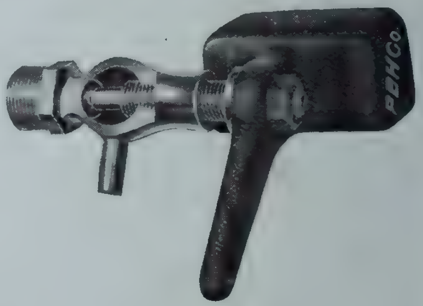
The ***"P.B.H."*** QUICK-CLOSING WATER GAUGE is an accident insurance against scalds and burns. If the glass breaks, a pull of the chain shuts off both the steam and water. Its structure is perfect; extra heavy body, best steam metal with extra large nuts for extra heavy washers. Less than a quarter turn of stem fully closes or opens valves. ***Sent on trial.***





Sectional view of Flue Cleaner Head

The ***"TORNADO"*** STEAM BOILER TUBE CLEANER not only does the work better than any other cleaner but does it in shorter time and more economically. Because the air injected by a small volume of steam carries no moisture to wet the soot, but blows it out through the longest tubes. **Sent on trial.**



The ***"P. B. H."*** QUICK OPENING, SELF-CLOSING GAUGE COCK; it is simple, efficient, economical and quickly repaired. It combines all the mechanical perfections which make it a GAUGE COCK. GUARANTEED LEAKLESS for years. ***Sent on trial.***

We also make the Mather Boiler Blow-off Pipe Protector. Have you seen it? Do you know what it is?

WRITE FOR CATALOGUE

The Paul B. Huyette Co., Inc.

1414 BETZ BUILDING, PHILADELPHIA, PA.

Selling Agents for Western Ontario and Northwest :

Canadian Steam Boiler Equipment Co., 186 Queen St. East, Toronto

Selling Agents for Province of Quebec and Eastern Ontario :

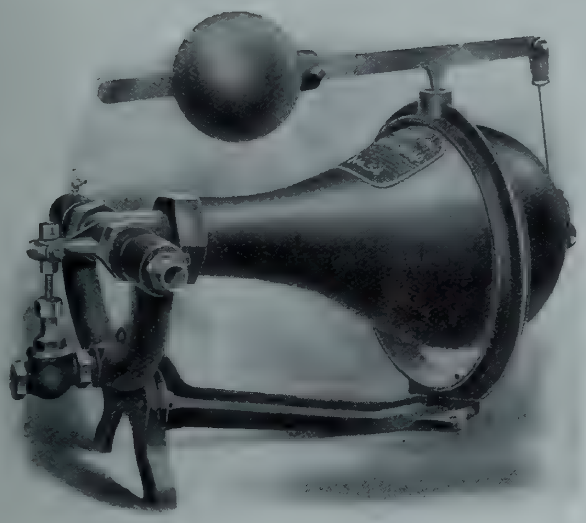
Peiler & MacKenzie, 52 St. James Street, Montreal, Canada

Selling Agents for Maritime Provinces and Newfoundland :

Peiler, MacKenzie & Lodge, Moncton, N.B.

The Reason Why

THE "BUNDY" STEAM TRAP



occupies its present unique position in the mechanical world is

Because The Results

achieved by its use, both in increased efficiency and decreased fuel bills,

Have not been attained through any other similar appliance.

Every owner, superintendent and engineer in whose plant steam is used for heating, boiling or drying, is interested in learning what we can do to decrease operating cost and to increase output.

We are effecting direct fuel economies of from 15% to 50% in some of the largest industrial establishments in Canada. No plant is too large and none too small to have the full benefit of our experience.

We are Specialists in condensation and we show results.

Catalogues and detailed information are available on request

PEILER & MACKENZIE, - 52 St. James Street
MONTREAL

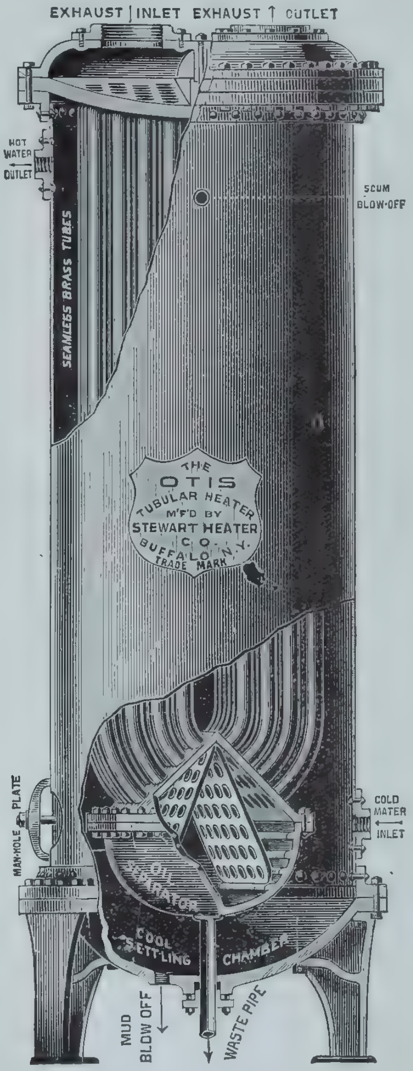
PEILER, MACKENZIE & LODGE - Moncton, N.B.

Sales Agents for

"BUNDY" Steam Traps and Separators

THE OTIS

Tubular Feed Water Heater, Oil Separator and Purifier



is not an experiment but a tried and trusted appliance that the makers are not afraid to

GUARANTEE

To heat the feed water to the *boiling point* (210 to 212 degrees) with the exhaust steam without causing any back pressure, *also to extract the oil from the exhaust*, so that the exhaust steam after being passed through the heater can be used for other heating purposes, and the water of condensation from the heating system be returned to the boiler without the *additional expense* of an *eliminator.* We also guarantee by the use of our Purifying System to remove all old scale from the boiler tubes and plates and prevent the formation of any new scale.

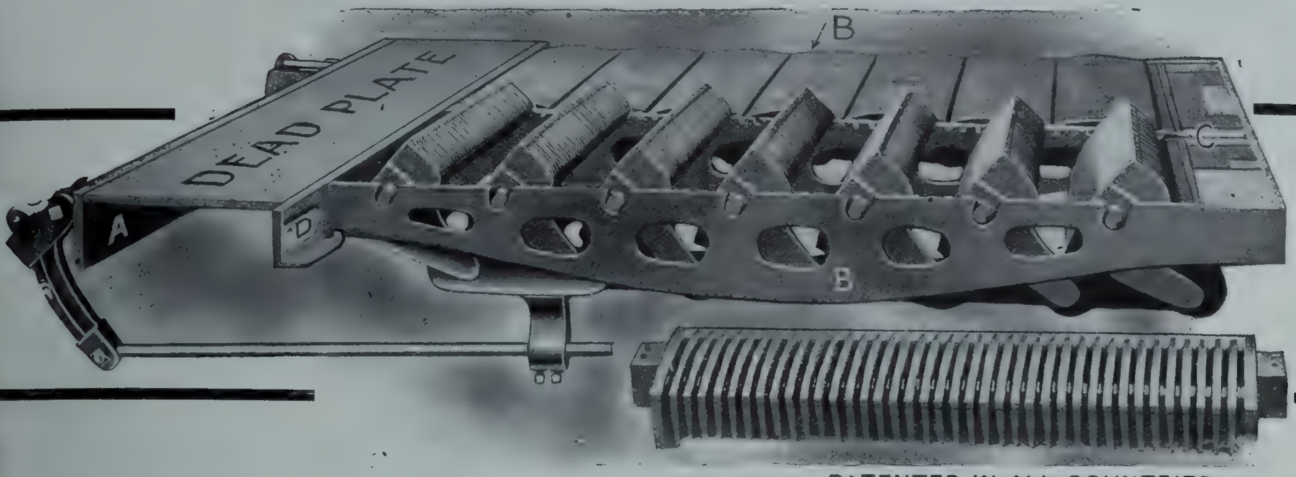
We are so sure of the OTIS that we agree to pay all cost of a trial—freight, cartage, piping, etc.—if it fails to do all we claim for it.

Catalogue and Prices at your Service

The Stewart Heater Company

189 Norfolk Avenue, Buffalo, N.Y.

The Grate that cuts down Fuel Bills



PATENTED IN ALL COUNTRIES

CYCLONE GRATE BAR

The "CYCLONE" will supply the greatest possible amount of air without wasting coal, and has a value in coal and labor saving that is equalled by no other grate.

The increased Air Space obtained by users of the "Cyclone" Grate, and the consequent increase of draught has proved most effective in producing more steam for fuel consumed, and the immense improvements in the shaking devices of the "Cyclone" absolutely prevent any ashes from clinging to the bars.

Here are a few more prominent features:—It locks level, cannot get out of adjustment, and cannot waste fuel when shaken, as the openings between the bars are no greater when shaken than when locked level.

Read wkat one delighted user says of the "Cyclone."

G. McA. Blizard, Esq.,
Canada Permanent Chambers, City.

Dear Sir—In reference to your inquiry, beg to state we have had the Cyclone shaking and dumping grate bars in use at our Water Street foundry for the past eighteen months.

We consider it one of the best grates of its kind on the market, and if we were installing any more boilers we would certainly use these grate bars, if they cost three times the money they do, as we consider we have saved double the price of the bars in the last winter.

Yours very truly,
T. McAVITY & SONS, LIMITED, St. John, N.B.

Circulars and further information yours for the asking.

Canadian Steam Boiler Equipment Company, Limited

(Sole Manufacturers for Canada)

186 Queen Street East, - TORONTO

AGENTS:

ST. JOHN, N.B.—F. W. Blizzard,
Canada Permanent Chambers.

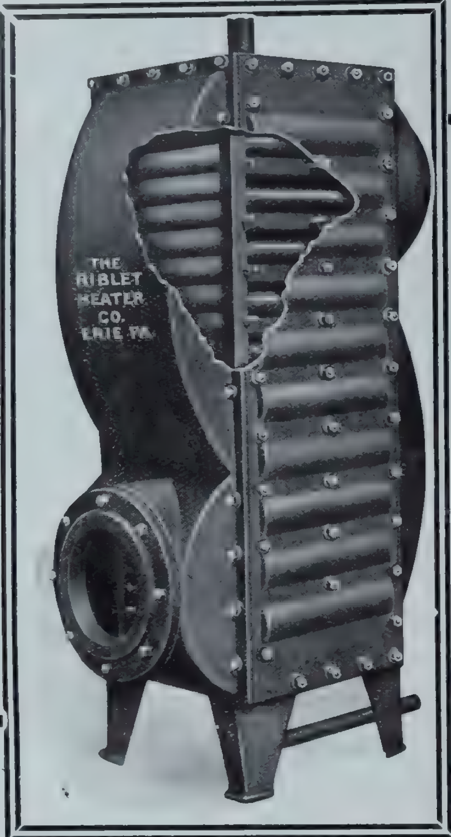
MONTREAL—Lowden & Mead,
18 Bleury Street

HAMILTON—Robt. Fitzsimmons,
8 Grove Street

WINNIPEG—Green & Lister, Heating Engineers.

The only Heater

that will heat water to the boiling point from a *Gas Engine* as well as from a Steam Engine is the



Transverse Current Water Heater

Being made of iron it will not easily corrode, and is not affected by electrolysis or acids. There are no tubes to scale, no joints to leak, and no floats to require attention. Water passages are easily accessible for cleaning, and it can't possibly get out of order.

You'll find this heater will more than pay for itself in fuel-saving in a few weeks.

Send for descriptive booklet.

The Riblet Heater Co'y

Box 18—ERIE, Pa.

General Agents in Canada

The Standard Engineering Co., Limited

47 Wellington St. W. - TORONTO

Belliss Engine Records

Regarding a Canadian Electric Lighting Station a well-known firm of Consulting Engineers writes:—

> "Since taking charge of this plant, we have investigated the record of these engines (all Belliss & Morcom), and find that during the three years of their operation they have given absolutely no trouble whatever, and we may say that it has hardly been necessary for our engineer to adjust the engines, which are on 24-hour service and running practically continuously in an engine room heated in summer to a temperature of 110 degrees."

McGILL UNIVERSITY

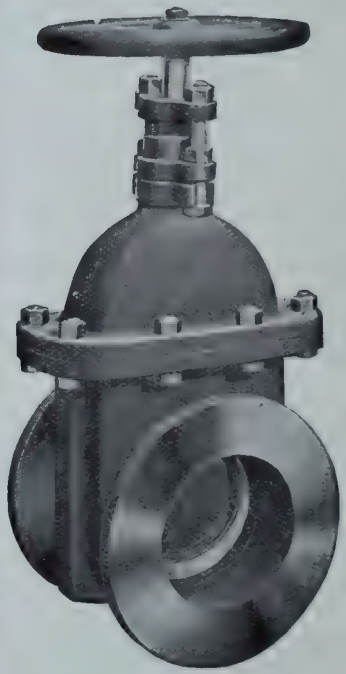
When requiring engines for their new Power House, after long and careful investigation, ordered Belliss Engines, and since their instalation and satisfactory performance have placed repeat order for third unit.

Shall we send you catalogue of Belliss Engines and Turbines?

LAURIE & LAMB

Consulting and Contracting Engineers

211-212 Board of Trade Bldg. :-: MONTREAL



KERR GATE VALVES

are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

Write for our Catalog of High Grade Brass and Iron Valves.

The
Kerr Engine Co., Limited

Valve Manufacturers

Walkerville, - Ontario

Dont let your money go up in smoke

THE COST OF SMOKE

¶ What proportion of the coal fed to the locomotive is actually used in power?

¶ About 6 per cent.; the rest is wasted.

¶ What part of the fuel value of their coal do the furnaces of the great manufacturing plants actually apply to driving the machinery?

¶ Not over 10 per cent.; often less.

¶ The rain of cinders from the locomotive, the pillar of black smoke from the factory chimney, account conspicuously for the waste. The great loss, however, is in the form o unconsumed gases which escape into the air without having been of any steam-producing value.

¶ These gases escape because, as is well known, perfect combustion has never been discovered as yet. The gases escape from the coal so rapidly that, before they are mixed with the necessary air (providing oxygen) they have passed away from the point of combustion—which is at the surface of the burning coal.

¶ The rescue of a small proportion of the 90 per cent. of fuel value thus wasted would mean a large proportion of the 10 per cent. now ordinarily used.

¶ This should be easily done.

¶ It has been done, and is being done. It can be done in every plant—in yours with the rest. Chemistry has produced in the *FISHER FUEL ECONOMIZER* a substance which when applied to the coal forms an exceedingly thin film over it and causes the valuable heat-producing gases to be held in the coal itself, and the coal and the gases are consumed together, thus preventing the waste of valuable gases which take place when the coal is consumed without the treatment.

¶ Indisputable evidence is available that by the use of

FISHER FUEL ECONOMIZER

Black smoke and flying cinders are eliminated, which has been proved on locomotives pulling the fastest passenger as well as the heaviest freight trains. Many evaporation tests in the power plants of the largest corporations in Canada show increase of efficiency ranging from 10 to 25 per cent.

¶ We save money for the factory owner and railway.

¶ We save the fireman much hard and dirty work.

¶ We save the black smoke which pollutes the air.

¶ We reduce your ashes and clinkers half.

¶ We increase and maintain steam to a degree which is impossible without the economizer.

¶ We keep your boiler tubes and grate bars clean, reducing expense of upkeep.

Let Us Prove It to You. Write To-day for Information

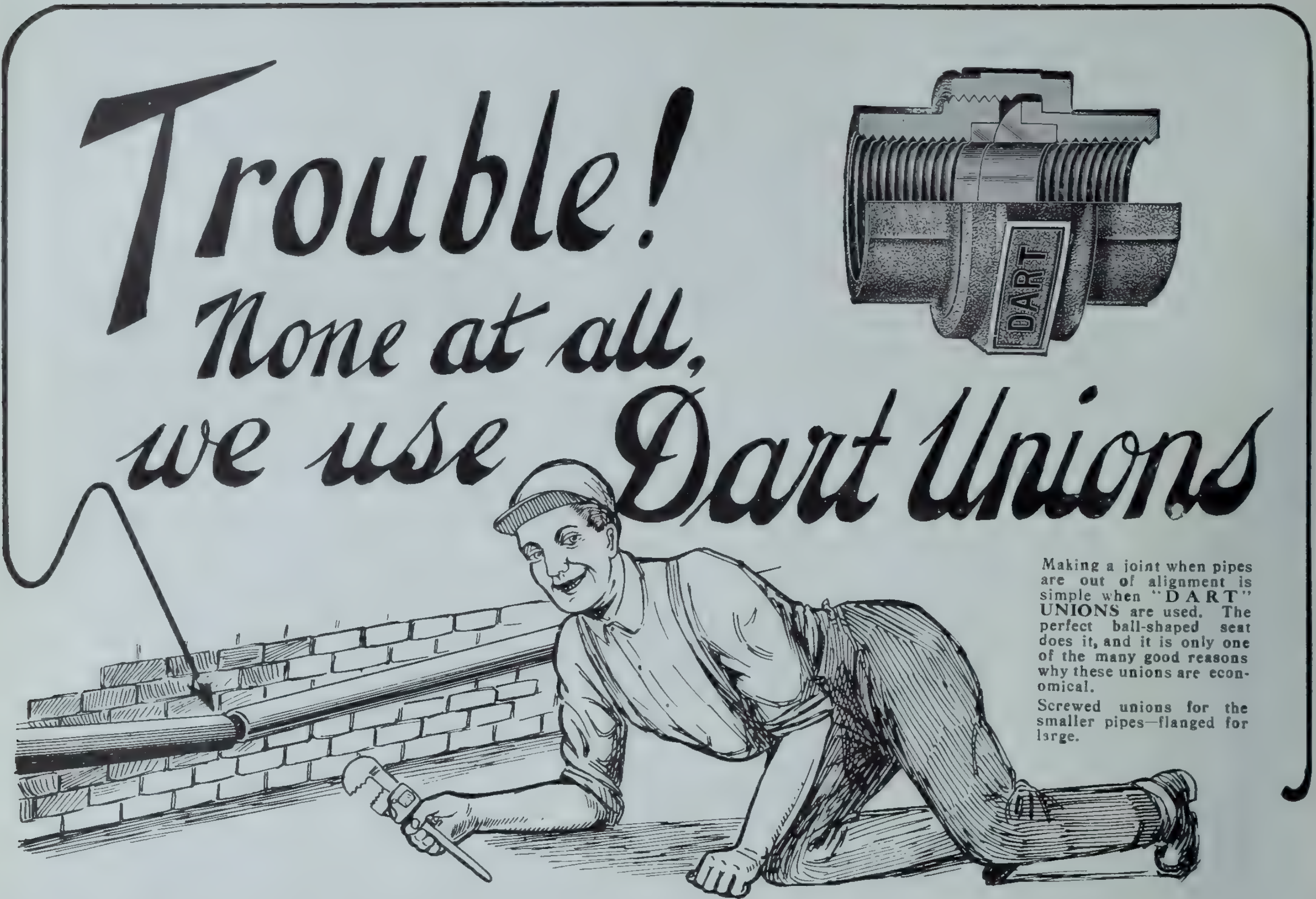
Phone Main 2390

Fisher Fuel Economizer Limited

Head Office, 74 Bay St., Toronto, Ont.

MONTREAL	OTTAWA	WINNIPEG
212 St. James Street	**35 Mackay Street**	**310 McGreevy Block**
Phone Main 3497	*Phone 1879*	*Phone Main 2750*

The advertiser would like to know where you saw his advertisement—tell him.



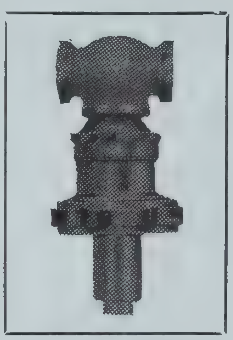
Making a joint when pipes are out of alignment is simple when "DART" UNIONS are used. The perfect ball-shaped seat does it, and it is only one of the many good reasons why these unions are economical.

Screwed unions for the smaller pipes—flanged for large.

Engineers! Quit Worrying!

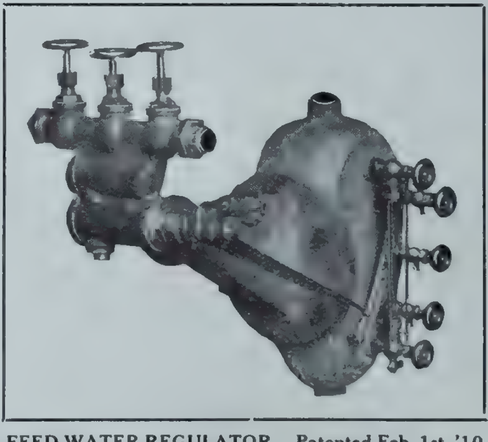
You can banish all your power plant troubles, and make your fireman look pleasant by using

W. H. BICE'S STEAM APPLIANCES



PUMP GOVERNOR
Patented April 19th, 1910

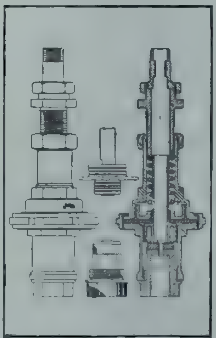
Try BICE'S SPECIALTIES for thirty days free, which will keep water at given level, give dry steam, save fuel and chase away all troubles which the engineer is heir to.



FEED WATER REGULATOR. Patented Feb. 1st, '10

Write for Testimonials and Price List.

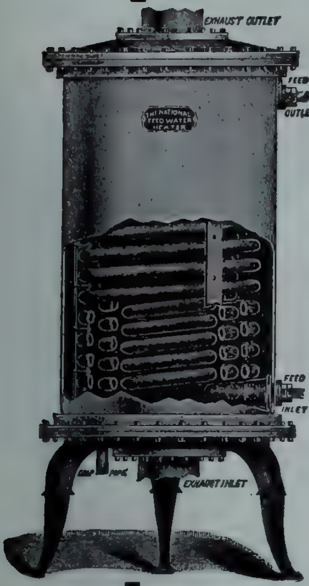
MANUFACTURED BY



REDUCTION VALVE
for water, steam or air,
Patent applied for

Automatic Feed and Regulator Company
100 Masonic Temple - - - LONDON, ONT.

Why Waste Heat?



If your exhaust steam is now going to waste, by installing a

National Feed Water Heater

you can use this exhaust steam to heat your feed water! There are no inside joints to leak in the "National," no leaky, straight tubes, no back pressure, and no contact of water with shell or iron. From one to fourteen coils of SEAMLESS DRAWN brass or copper tubing are encased in a cast iron or steel shell to which EXHAUST STEAM is admitted, heating the water which passes through the tubing.

Send for booklet on Feed Water Heating.

It's yours for the asking.

The National Pipe Bending Co.

91 Lloyd Street NEW HAVEN, CONN. U. S. A.

LUNKENHEIMER AUTOMATIC INJECTOR AND EJECTOR

Excel those of any other known make. They will deliver more water per pound of steam than any other, which means a saving in fuel, and the maximum capacity can be graded over 50 per cent.

LUNKENHEIMER AUTOMATIC INJECTORS

LUNKENHEIMER EJECTOR

will lift water quite a height, take very hot water and will force against a much greater pressure than that of the boiler. They are made in five types to facilitate connecting.

Your local dealer can furnish them.
If not, write us.

Write for Catalogue

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Largest Manufacturers of high-grade Engineering Specialties in the world

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—BRANCHES—

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66-68 Fulton Street

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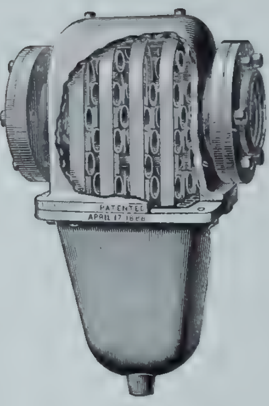
LONDON, S.E., 35 Great Dover Street.

43



THE

LOWDEN

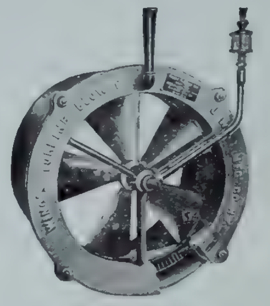
Grit and Oil Extractor

Made by

Chas. J. Jacobs & Co.

42 Oliver Street
BOSTON, - MASS.

"Wing Turbine Blowers" For Forced Draft



Exterior View

Interior View

A combination of two well-known machines, **Wing's Disc Fans or Blowers** and a simple, practical, **Turbine Engine.** The engine consists of a series of buckets or vanes fastened to the outer ends of the Fans or Blower Blades to receive the impulse of steam, and three or more nozzles from which the steam impinges on the turbine buckets that are especially designed to get the highest possible value of the expansion of steam, and thus give a positive and economical power to drive the Blower.

For Forced Draft the small amount of steam that drives the Blower, passes in under the grate with the air, thoroughly mixed, and gives the most perfect combustion ever obtained by any mechanical or natural draft system.

Each boiler has its individual Turbine Blower, which is placed in the side or in the rear wall, as shown in illustrations.

The price of the Blower is moderate and the cost of installation small, while the saving in fuel is greater than by any other system.

The Blowers are strong, well built and require no further attention than to see to the lubrication.

The system when installed complete is absolutely automatic in operation.

Agents wanted in the various districts of Canada.

MANUFACTURED BY

RUSSELL & GIFFORD

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THE

DUFFY STEAM TRAP

To introduce the DUFFY STEAM TRAP to every Canadian Engineer, I will, on request, send one on 30 *days' free trial.* Test it any way you can think during that time, and if you don't find, as hundreds have done, that it more nearly approaches the ideal sought after, than any trap on the market, send it back at my expense.

Its distinctive feature is the expansion and contraction of iron pipe in coil, as shown in cut. It possesses large draining capacity, and will drain system when steam is shut off, thus preventing danger from frost.

Send along your request for one of my traps on trial—to-day.

Francis Duffy - 136 Stuart Street - Kingston, Ont.

For Your Steam Lines

¶ **COST OF FUEL** is one of the greatest problems connected with the operation of every Power Plant. The question of how to *keep down* coal bills is always under consideration.

¶ Morehead Return and Non-Return Steam Traps afford the best, most effective and satisfactory method of handling your steam line condensation—returning it to the boiler as feed water, *pure and hot.*

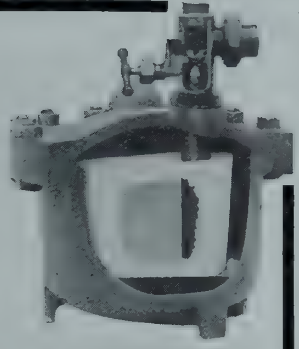
¶ Expressed in a few words, the Morehead Trap saves fuel.

Write for "Trap Book"

MOREHEAD MFG. CO.
Dept. "J" - DETROIT, MICH.
Canadian Representatives:—A. R. Williams Machinery Co., Toronto; W. H. Markle, Montreal; Park Bros., Chatham, Ontario.

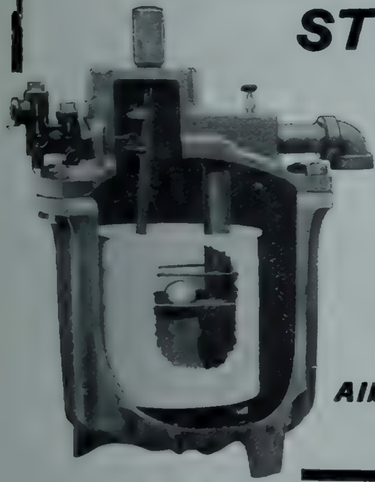
Steam Trap Knowledge,

gained by over 40 years' experience, is the backbone of the design of



Non-Return

THE ALBANY STEAM TRAP.



Return

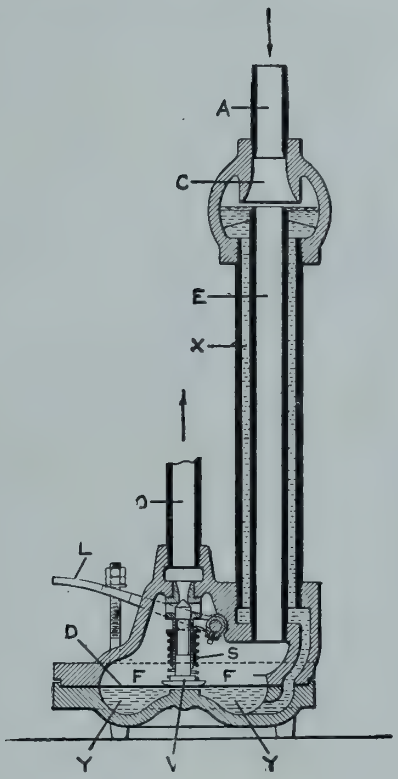
Use OUR brains to solve YOUR trap troubles.

The Albany Steam Trap Co.
Albany N.Y.

THE NO TROUBLE STEAM TRAP

IS

THE FLINN



No buckets, no floats, no expansion, no joints to pack, nor any similar trouble makers.

The trap is simplicity itself and is sold under our positive guarantee.

Richard J. Flinn

WEST ROXBURY - MASS.

CANADIAN AGENTS:

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if you are a subscriber to "THE POWER HOUSE." If you are not a subscriber, send in your own subscription together with two, three or six others, and the indicator you are entitled to will be mailed to you immediately.

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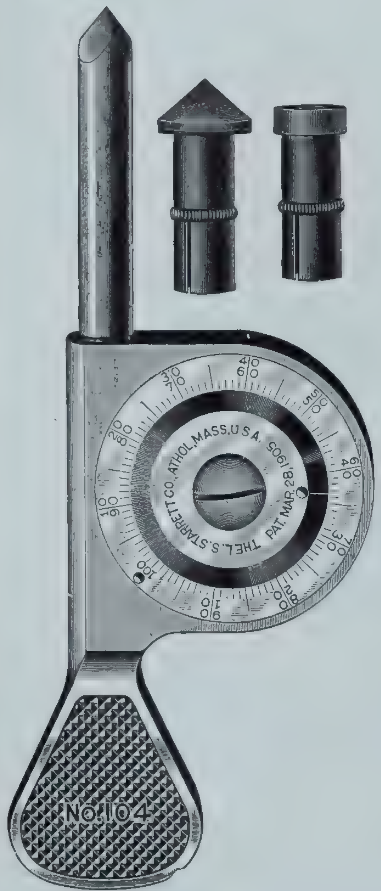
STARRETT HIGH SPEED INDICATOR, No. 104
Value $1.00
Given for two yearlv paid-up subscriptions.


THE L.S.STARRETT CO. ATHOL, MASS. U.S.A.
PAT. MAR. 28, 1905
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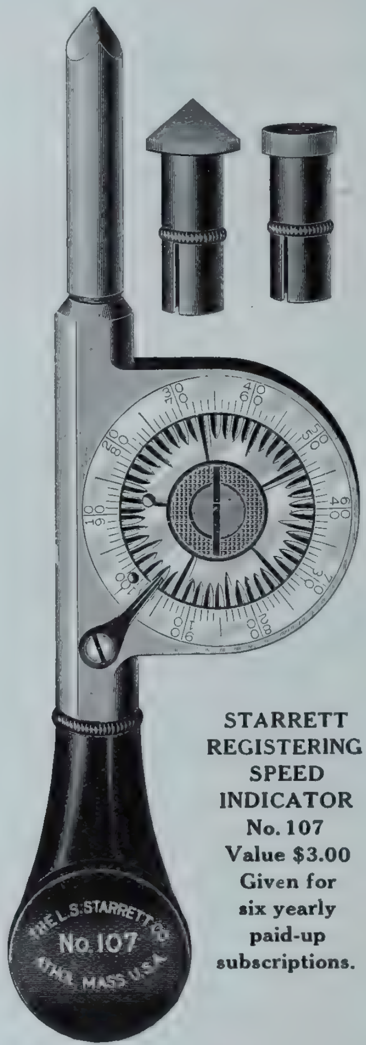
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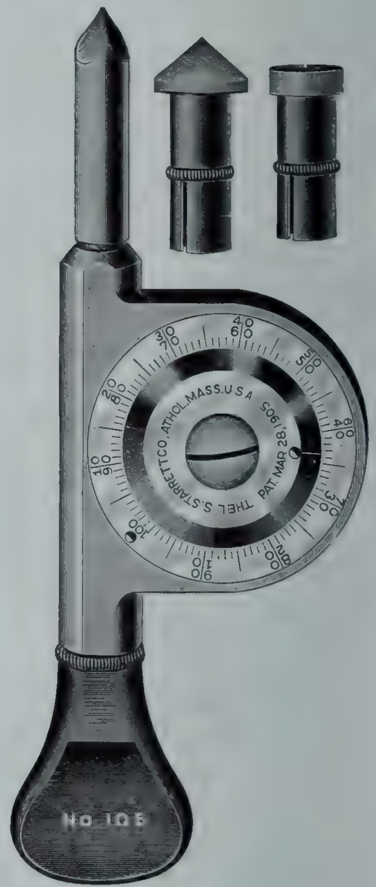
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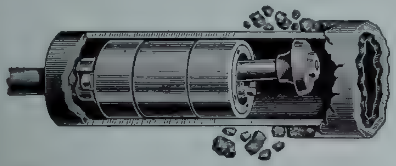
Boiler Scale An Enemy To The Coal Pile

You can't generate steam with scale-incrusted tubes without wasting 10 to 30 per cent. of your fuel. Nor without having leaky and burned out tubes and having trouble in getting up steam.

The Dean Boiler Tube Cleaner

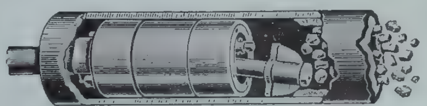
will save its cost several times over by solving the scale problem for you. It produces results that both the engineer and owner can see. It is guaranteed to pay for itself in six months' use.

Write TO-DAY for further particulars and our free trial offer

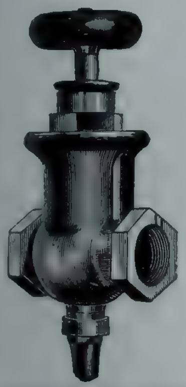


The Dean removing scale from the tube of a return tubular boiler.

THE WM. B. PIERCE CO.
330 Washington Street, Buffalo, N.Y.
Montreal Office : 230 Coristine Bldg., Montreal.



The Dean removing scale from the tube of a water tube boiler.



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It is your protection against poor goods and poor service. See that you get it.

Balanced Steam Trap	Damper Regulator
Return Steam Trap	Temperature Regulator
Expansion Trap	Improved Pressure Regulator
Separator	Tank Governor and Pump

These and other specialties described in our catalogue. Write for a copy.

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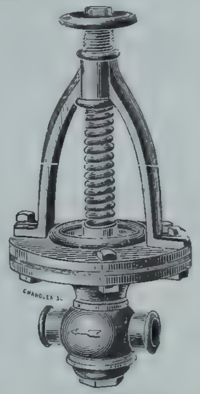

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Will outlast anything on the Market.

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A SET OF

The "F & W" Metallic Packing

ON A 30-DAY TRIAL—MONEY-BACK PROPOSITION

Give diam. of rod, length and diam. of stuffing box, piston speed, pressure and service.

The POWER ECONOMY CO.

We can supply anything you need in your power plant.

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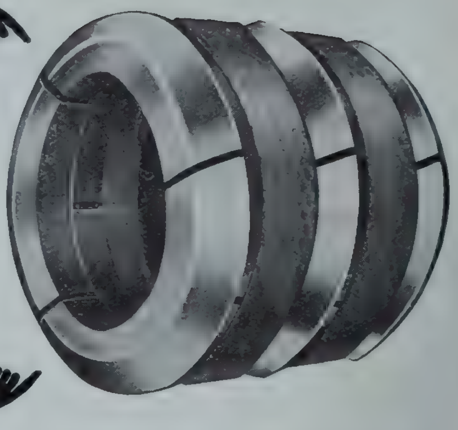

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TRI-SODIUM PHOSPHATE

Purest Commercial, 100%, for prevention of scale in boilers.

WAREHOUSES:
Toronto, Ont.
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Notice! Engineers

Always Buy the Best. It Pays. You Can't Go Wrong When You Specify

It is decidedly superior to every other make.
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Manufactured and Guaranteed By

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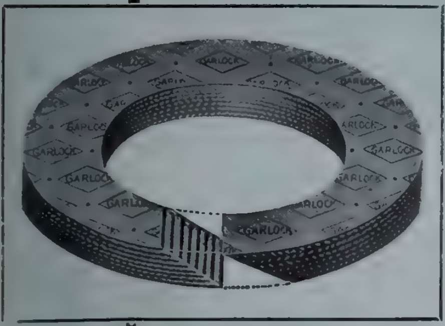
IN DAYS OF OLD—

when Garlock Packings were patented and placed on the market, the superior merits were at once recognized, and to-day



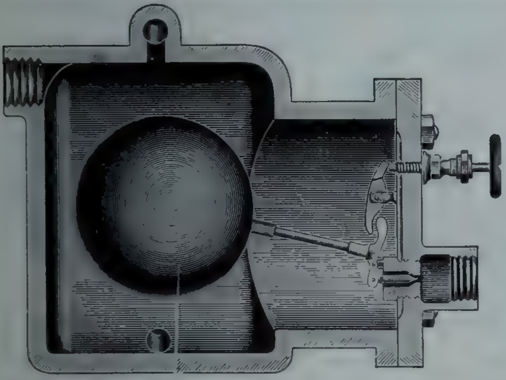
THE GARLOCK PACKING CO. TRADE GARLOCK MARK HAMILTON CANADA. GARLOCK THE GARLOCK PACKING CO. TRADE GARLOCK MARK HAMILTON CANADA.

RING AND SPIRAL PACKING

continues to hold first place in the esteem of the engineer.

The current high prices of raw materials may make a difference in price, but not in the quality of Garlock Packings.

The Garlock Packing Company
HAMILTON, ONTARIO



The Steam Trap that Never Fails

"RELIANCE"

Its simplicity of design, its strength of construction, and its unlimited capacity, combine to make it the **one perfect trap.** The Reliance will handle every drop of condensation. whether it comes in driblets or in floods. The valve is controlled entirely by the inflow of the water with an action that is positive and never-failing, working equally well on high and low pressure systems. If you wish to draw out the trap or blow out the sediment, simply turn the hand wheel and the work is immediately accomplished. To inspect the trap remove four small nuts and the simple internal mechanism comes out with the trap.

Every Reliance Steam Trap is Fully Guaranteed—Including the Float.

Write for our illustrated Catalog.

The Reliance Gauge Column Company
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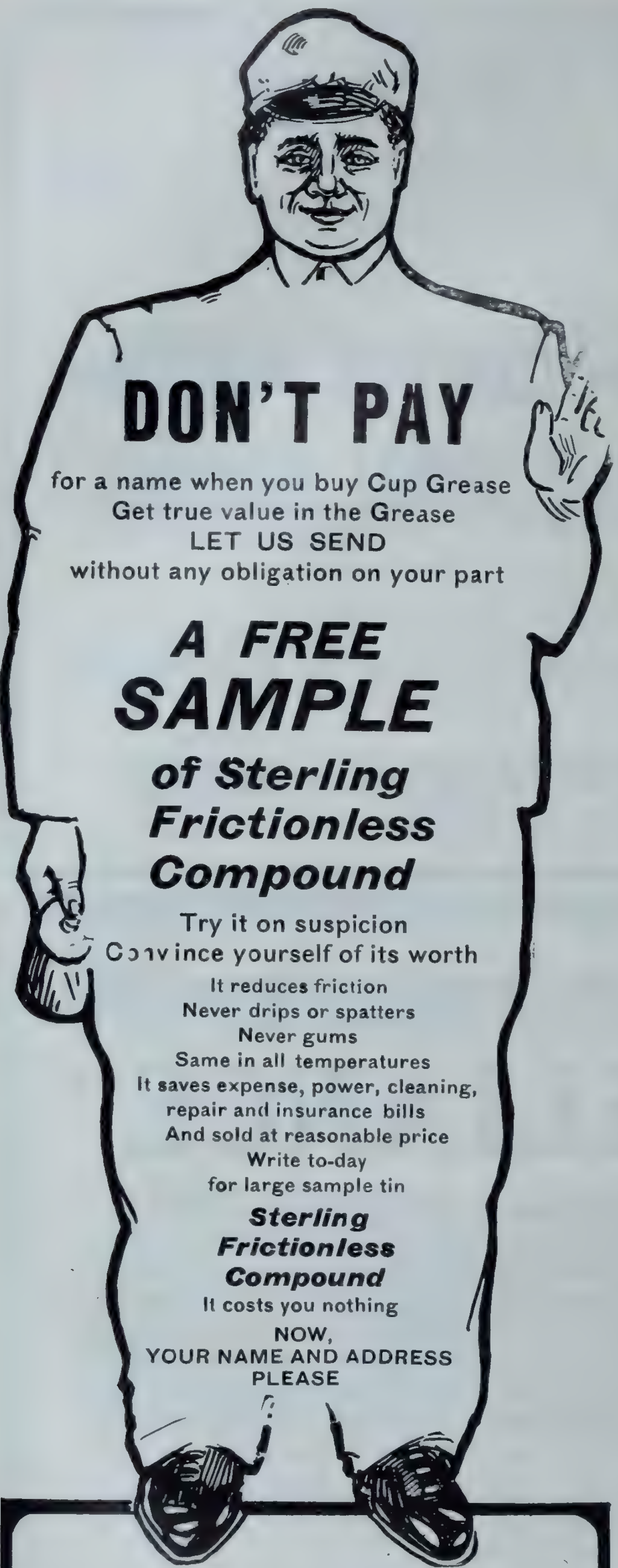

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for a name when you buy Cup Grease
Get true value in the Grease
LET US SEND
without any obligation on your part

A FREE SAMPLE

of Sterling Frictionless Compound

Try it on suspicion
Convince yourself of its worth
It reduces friction
Never drips or spatters
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Same in all temperatures
It saves expense, power, cleaning,
repair and insurance bills
And sold at reasonable price
Write to-day
for large sample tin

Sterling Frictionless Compound

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NOW,
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Canadian Oil Companies LIMITED
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Distributing Depots at all points in Canada

ONLY ONE ADJUSTMENT is necessary. The visible feed is controlled entirely by a threaded valvestem.

Ratchets—plunger travel adjusting screws—ratchet wheel shoes—lever movement variations—NO—nothing like that in the Richardson Family.

A postal brings you an interesting story told in Bulletin 209.

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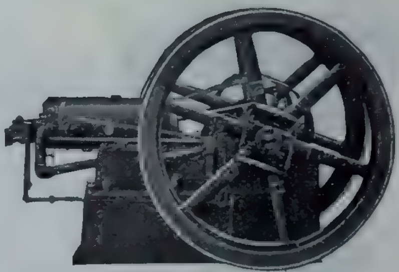

You can absolutely depend on an I.H.C. Engine to do the work right—at the lowest price. Thousands of power users have found I.H.C engines to be most dependable, simple, economical, powerful and durable. You will too. There is

One To Meet Your Needs

Whichever I.H C. Engine you choose, will net you the biggest returns. 1 to 25 Horse-power, vertical or horizontal, portable or stationary, water-cooled or air-cooled—choose the one that suits you Traction Engines in sizes 12, 15 and 20 Horse-power. See the Local International Agent to know all the I. H. C. advantages—or write direct to us for catalogues and any information you want.

International Harvester Company of America
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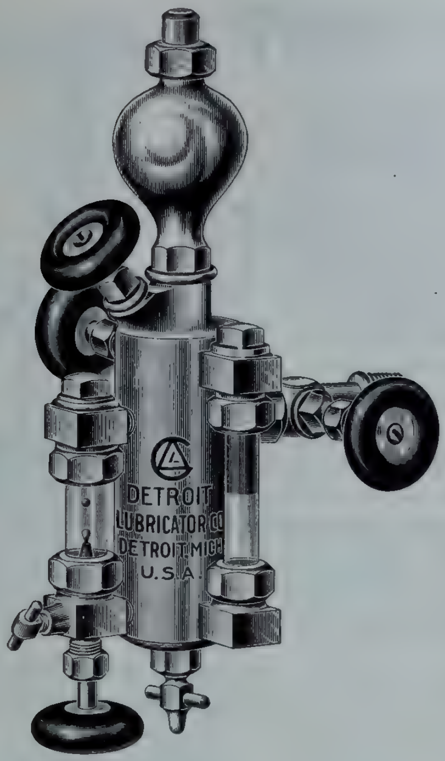
50 Harvester Bldg. CHICAGO, U.S.A.

Genuine "Detroit"-Improved Standard Lubricator



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Simple in theory.

All that skill and money can produce in construction.

Dependable in practice.

Every "Detroit" Lubricator is carefully inspected before shipping.

The first "Sight Feed" Lubricator was originated by the Detroit Lubricator Co. over thirty years ago.

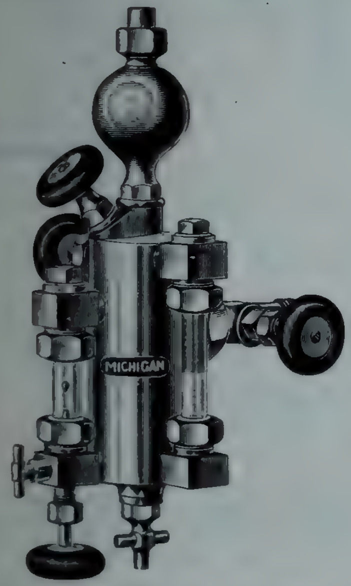
To-day we operate the largest plant devoted to the manufacture of Lubricating Devices in the World.

Be sure you get the Genuine "Detroit".

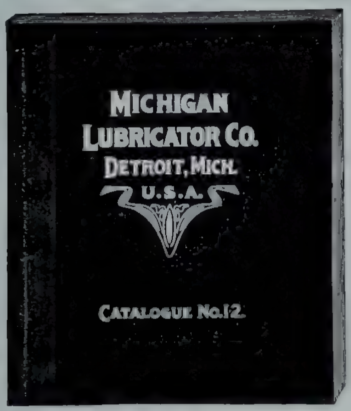
DETROIT LUBRICATOR COMPANY.
DETROIT, U.S.A.

MICHIGAN

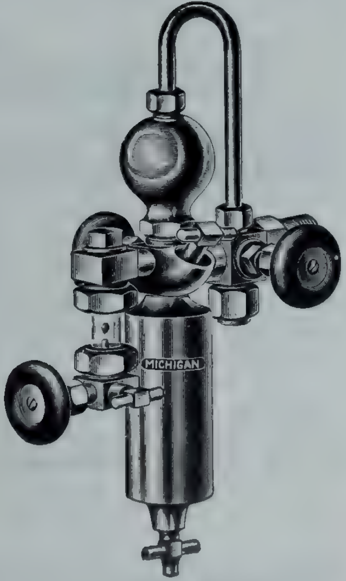
Illustrated catalog mailed to you free



Improved Double Connection,

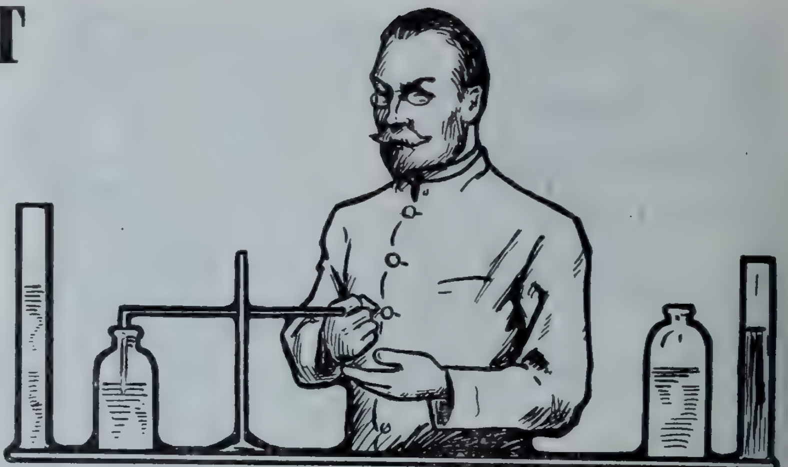


WRITE TO-DAY



Improved Single Connection.

MICHIGAN LUBRICATOR CO.
DETROIT, MICH.



GET TO THE ROOT OF THE MATTER

In dealing with the Scale Problem, even those who have no scientific knowledge agree that **one** STOCK BOILER COMPOUND never did and never can rid **several different waters** of their scale-forming elements. A complete mineral analysis is as essential to finding out what the salts are which are causing the scale in your boiler, as a medical examination is necessary to diagnose a patient's complaint. We don't pretend to remedy the trouble until we have ascertained the cause:—Then treatment can be furnished that will contain the exact reagents required and CLEAN BOILERS ARE ASSURED,

For 25 years we have specialized in Boiler Scale Treatment, and we offer you **free** this Laboratory Service and advice.

SEND ALONG ONE GALLON OF YOUR ORDINARY FEED WATER, and describe you plant conditions. We'll do the rest! Write for booklet describing our methods and equipments.

DEARBORN DRUG AND CHEMICAL WORKS

THE PIONEERS OF SCIENTIFIC WATER TREATMENT

Office, Laboratories and Works : : : : : CHICAGO, U.S.A

Be Logical!

It's far more profitable to keep in health than to pay doctors' bills, and it's far easier and more profitable to *prevent* scale forming in your boiler by using the

International Boiler Compound

than to remove it after it has formed.

We make an individual analysis of each feedwater submitted to us free of all charge. Express us one gallon of the water you are using, and we will forward a *trial sample* of our compound guaranteed to remove *all* scale-forming elements.

This is a unique opportunity you should not fail to seize. It will mean the saving of much work, coal and trouble to you.

You can make money acting as our agent in your district. Write for details of our offer.

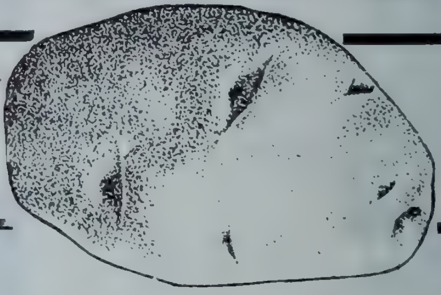
Get in touch with us to-day.

International Boiler Compound Company

144-146 West Michigan St., Chicago, Ill., U.S.A.

"Prevention is Better than Cure"

An old proverb which was never so true as when applied to the ***Scale Problem !***



Prevent the formation of Boiler Scale by treating your Feed Water with

POTATO SCALE BOILER CLEANSER

It will save fuel, keep your Boiler from foaming and is guaranteed not to injure tubes, shell or connections. Send me one gallon of your ***Feed Water*** and I will forward a compound which I will guarantee to free your Boiler from scale and to keep it free.

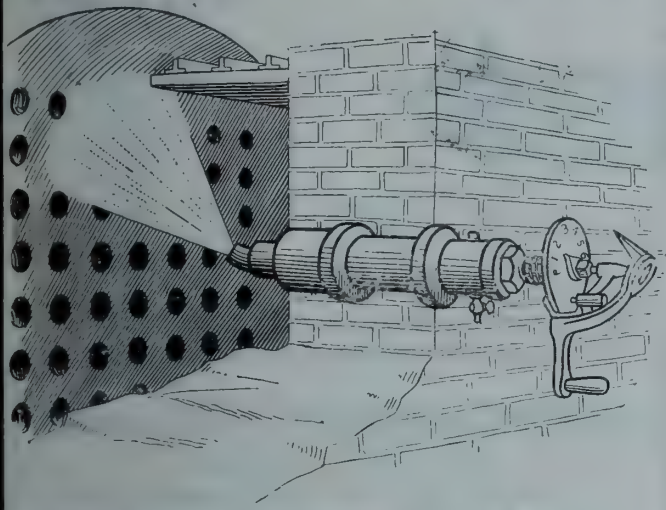
Sole Agent in America **C. C. SNOWDEN**

All letters to Calgary **Calgary, Alberta**

SOOT

The Quick, Easy Way to Get Rid of it

CLEAN the boiler tubes four times a day. Two minutes for the job—eight minutes a day. Do it without exertion —thoroughly—easily—without the disagreeable features usually accompanying this job. Soot-clogged tubes mean loss of heat—extra firing—extra fuel—cost. There is a simple, logical, reasonable way to avoid this work and waste—a way to get more work out of your boiler with less work on your part and with less expense to your employer. Let us send you, *on trial*, the



"Diamond" Flue Blower

—has saved as much as 10 per cent. on fuel. No more steam hose to buy. The blower is a permanent fixture, set in the wall. It drives a powerful spray of dry, superheated steam through the tubes, forcing every atom of soot, with the draft, out through the stack.

Our Free Trial Offer—We will send you a blower on trial. If it is not exactly as we represent, we will take it back and pay freight both ways.

Economical Production of Steam is a booklet which tells you how to operate your return tubular boiler to the best advantage. You'll find on every page something to help you. Fill out and send in the coupon to-day. Your book is waiting.

"Diamond" Power Specialty Company

317 Fort Street West, Detroit, Michigan

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Tear out and mail to-day.

"Diamond" Power Specialty Co.,
317 Fort Street, Detroit, Mich.

Gentlemen: Without obligating me in the least, you may send me free a copy of your book, "Economical Production of Steam," which I understand is a practical treatise on the operation and maintenance of the "fire tube" type of boiler.

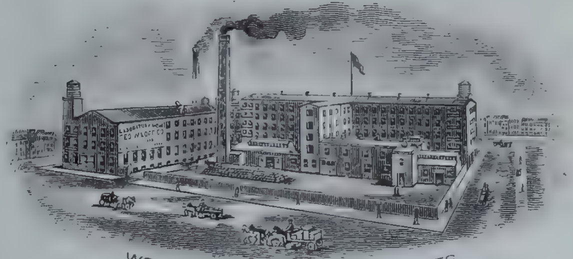
Name ....

Address..

City...

Employed by...

Number and Capacity of Boilers in Operation...................................



WORKS, DAUPHIN AND DELHI STS.

YOU CAN'T GET AWAY FROM THESE FACTS

If there is scale in your boilers you are burning more fuel than is necessary.

If there is no scale, but the boilers and tubes show pitting and corrosion, you are running a risk that no wise business man would take, for an explosion is liable to occur any time.

Our business is to supply chemicals that will counteract either condition, therefore we make you the following proposition:

If you have scale, send us a sample.

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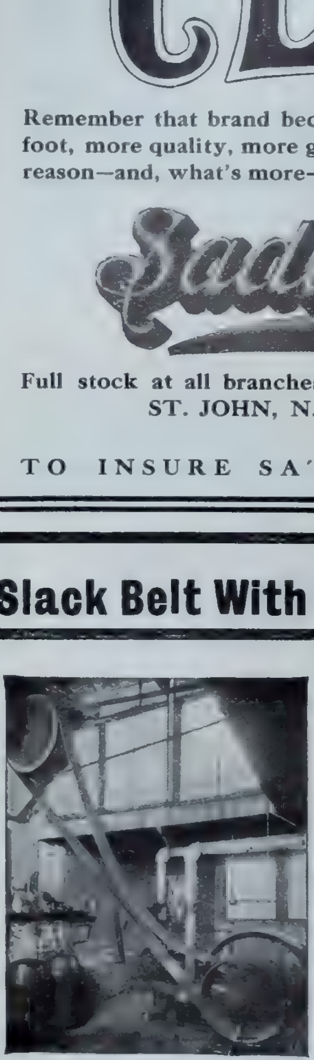

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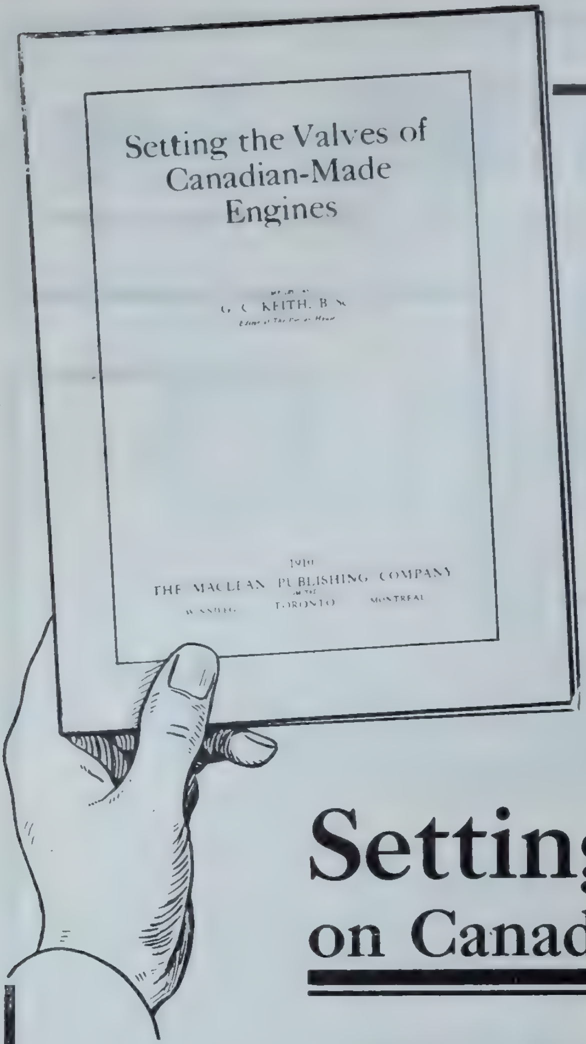

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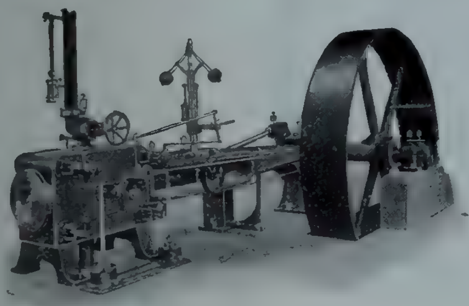

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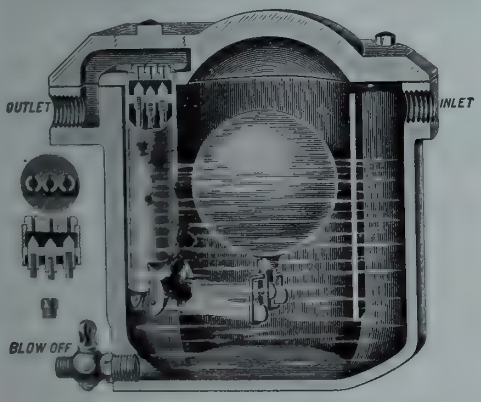

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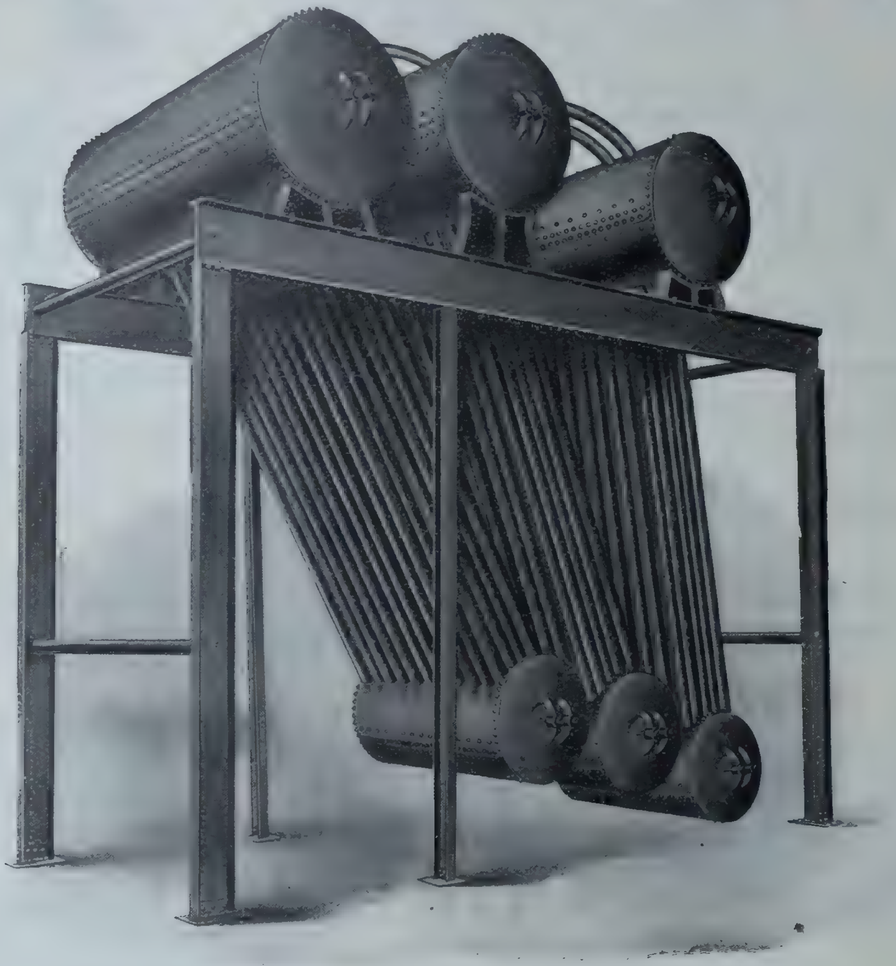

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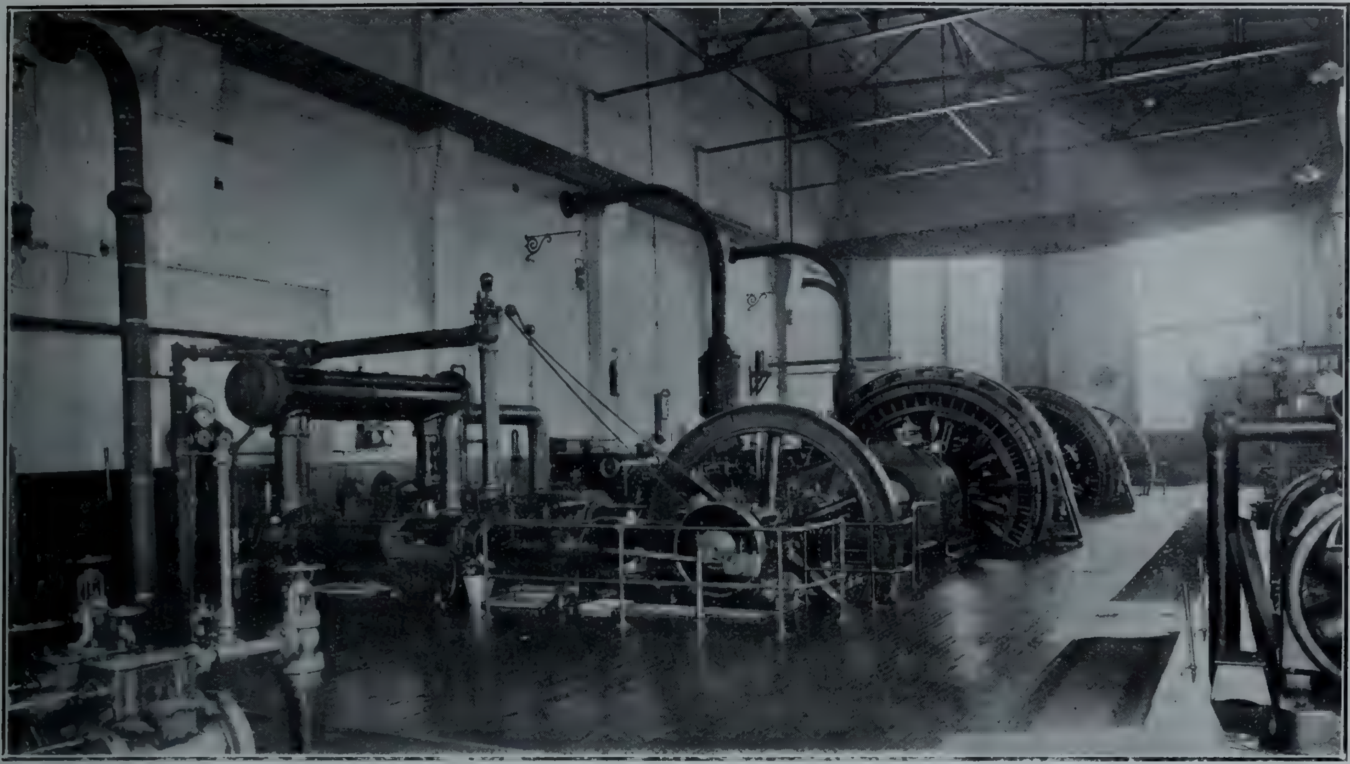


Interior View of Generating Station, C. P. R., Weston, Man.

Power Generating Station of the C.P.R., Weston, Manitoba

Boilers, Engines and Auxiliary Machinery of the Power House—Development of this Western Railway Plant—Conveniently Arranged Station.

Staff Correspondence.

The C. P. R. shops at Weston, a suburb of Winnipeg, are quite extensive, covering a considerable tract of land. The individual buildings are of the latest design, and the equipment thoroughly up-to-date.

The power plant, of which two photos are reproduced is worthy of special mention. Power for both motors and light is supplied for all the shops from this plant, as well as lighting for the 110 miles of tracks within the city limits. It is contained in a building 169 feet long by 97½ feet wide, of plain brick and steel construction. The boiler room, which is separated from the engine room by a solid brick wall, contains eight 250 h.p. Babcock and Wilcox Water Tube Boilers, carrying 130 pounds pressure, each fitted with a B. and W. patent superheater, and two Green Fuel Economizers.

Four of the boilers are equipped with the B. and W. stoker and chain grate, two with the Rooney stoker, while the remaining two are fed with refuse from the planing mills and wood shops. Draught is obtained from fans located on a platform above the economizers, which forms a very compact arrangement.

The boilers supply two 750 h.p. Rice & Sargent Cross Compound engines, direct-connected to two 500 k.w., 500 volt, A.C. generators, built by the Canadian General Electric Company. Two 25 k.w. exciter units are driven by simple engines. There are also two Canadian Rand Air Compressors, each with a capacity of 1,500 cubic ft. of free air per minute. In addition to these are two Underwriter Fire Pumps, and two general service pumps.

The switchboard, of blue Vermont marble, has a separate panel for each machine.

The engine room is attractively fitted, with pressed brick walls, waxed hardware floor, and with engines and generators well polished.

WINNIPEG WIRING BY-LAW.

(Staff correspondence).

The many fires that have occurred in Winnipeg within the past few months has increased the interest in the "Iron Conduit Wiring By-law," which went into effect on January 1 last. To compel all instalations of lighting and power wires to be enclosed in iron conduits for the safeguard of public interests was at first thought to be drastic legislation. But as is the case with all new well-advised regulations, opposition must be expected, and in this case the need was felt to be so urgent that in the face of all the opposition, the by-law was maintained with all rigidity, and now it is looked upon with more favor.

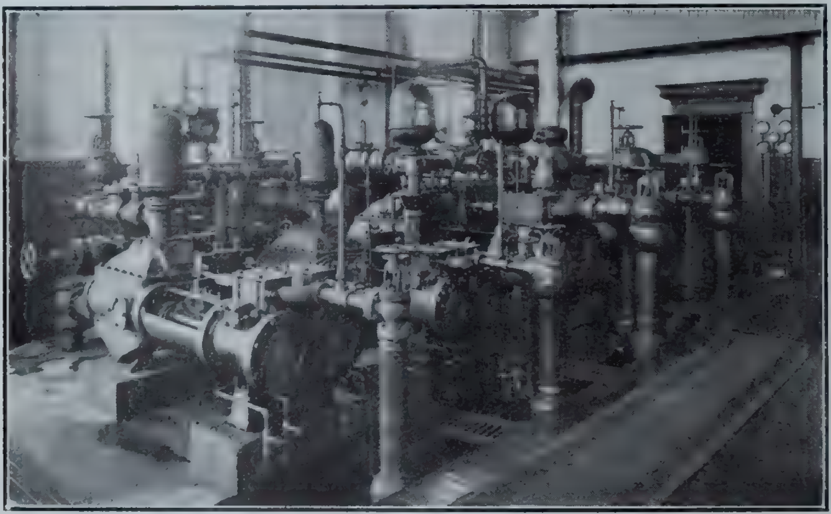
City Electrician F. A. Cambridge, a member of the International Electrical Association, was mainly responsible for the introduction of the new by-law. It was pointed out by him that the leading United States cities were convinced that the conduit system was the only remedy for safety against fires due to defective wiring. It is so often the case that wiring is tampered with by men working around buildings and changing the wiring after the work has passed the inspection of the electrician, and fires are caused by the disarrangement of wires.

There is no proof that the two fires which did such tremendous damage in

Winnipeg recently were caused by a defection in the wire system, but it is not unlikely that this was the basis of the trouble. At any rate, a small fire occurred recently in a store in Winnipeg where a gas-fitter had brought pipes into contact with wires, and holes were burned through the piping, causing a flame.

The chief objection to the conduit bylaw was given by the manufacturers and those interested in furthering the manufacturing interests of the city. The argument that Winnipeg is the only Canadian city to bring about this legislation was advanced, but it has been learned since that other leading Canadian cities were considering the same by-laws. It is evident that many manufacturers have ignored Winnipeg on account of the by-law under which they would have to operate. A manufacturer recently opened a plant in a western town, where no limitations whatever were offered. There is no electrical or building inspector, and the fire protection is not the best.

The question arises, is the cost of instalation outlined by the building bylaw so great as compared with the cost of the structure that the manufacturer is warranted in seeking a free site where he is not properly protected? Inspector Cambridge said that manufacturers were beginning to realize that the protection given them by such by-laws as the conduit legislation, was of greater value to them than the most flattering inducements to locate in cities where they were not protected. The step Winnipeg has taken is the step every Canadian city will take in time when they fully realize the necessity of scientifically safeguarding public interest.



Pumping Machinery, C. P. R., Weston, Man.

John M. Leslie, B.A.Sc., lately Fellow in Electricity, University of Toronto, is designing with the Canadian Westinghouse Co., Hamilton.

Purifyng the Water Supply of the City of Toronto

Bleaching Powder was Used to Purify the Water Supply, the Powder was Dissolved and the Solution Poured down the Mouth of the Intake.

By Gordon C. Keith

THE engineer of Toronto has had troubles with the city's water supply. The water is now being purified by pouring bleaching powder down the intake. Bleaching powder or chloride of lime is an important article of commerce which is extensively used in bleaching the coarser kinds of cotton and linen goods. It is also used as a disinfectant and as an antiseptic, that is, for the purpose of destroying disease germs and of preventing decomposition of organic substances.

Its chemical formula is usually represented as $Ca\ (O\ Cl)_2\ X\ Ca\ Cl_2$. Chemists affirm however that the composition is $Ca\ O\ Cl_2$ when in the dry form. Bleaching powder is made by treating slaked lime with chlorine. In the above, the formulae mean as follows :

$Ca\ (O\ Cl)_2$ equals Calcic Hypochlorite.

$Ca\ Cl_2$ equals Calcic Chloride.

In being used for purifying Toronto's water supply the powder is deposited in a barrel full of water, where it is dissolved. The liquid is then allowed to run through a tap into a trough, and from the trough it is allowed to run slowly into a pail with a hole in the bottom. From the pail it runs into a funnel, and from there into the tunnel shaft.

Work of Disinfecting.

The work of preparing for the disinfecting is a difficult task. The powder could not be thrown in the water in bulk, but has to be carefully dissolved in a small quantity of water and allowed to run in liquid form into the tunnel shaft. There will be three to five of powder to one million gallons of water, and in these quantities the uowder and water will be thoroughly mixed as it passes through the water tunnel to the city mains.

Results.

The analysis of a sample of water taken from the tap at the City Hall, after a week's use of the powder showed that there were no coli communi present, and there has been an appreciable reduction in the number of colonies of bacteria—5,500 on March 19, and 320 on March 23. The record for the four days was as follows :

	Colonies of bacteria per c.c.
March 19th	5,500
March 21st	990
March 22nd	420
March 23rd	320

Acting Medical Health Officer Wilson stated that water with 500 colonies of bacteria per centimeter is considered good water for drinking purposes without boiling.

About 150 pounds of bleaching powder were used per day to purify 35,000,000 gallons, which is the city's water supply for a day. The mixing of calcium hypochlorite with water liberates oxygen which acts as a disinfectant. Besides being used as a water disinfectant calcium hypochlorite could be used to advantage to disinfect sewage. By adding a few pounds per million gallons the germs would practically all be destroyed.

A new and greatly enlarged edition of "Feed Water Filtration," is being distributed gratis by James Beggs & Co., 109 Liberty Street, New York. This book explains how oil, dirt, etc., get into feed water, what damage they do within the boilers, and how to remove such impurities before this can occur. It tells how water of condensation and returns from heating systems may safely be used to cut down the coal and water bills, and it explains the advantages and disadvantages of various methods of filtration. Numerous instances are cited where filtration through terry cloth at the last point in the line before water enters the boilers has proven successful after other methods have failed. The Blackburn-Smith Feed Water Filter and Grease Extractor is described in detail. Engineers will find this book well worth writing for.

Efforts Being Made to Secure Smoke Abatement

What the Cities of the United States are Doing. Information for Power Users for Securing Better Combustion of Fuel.

By R. C. HARRIS*

Were I to give a resume of the crusade against smoke in Great Britain during the past three hundred years, and the late experience of America in this regard, it might prove entertaining and perhaps instructive. My function, however, is to deal not with the historical, but rather the recent and passing phases of the war waged for a clean, healthful, uncontaminated atmosphere. At one time, a cloud of smoke was considered an index of commercial prosperity, and a city suffocating beneath a carbon laden gaseous pall was envied because of its apparent material success. To-day, we know, and stand prepared to prove, that smoke is unsanitary, spells **Waste** and improvidence, is destructive of property, tree and flora, and indirectly the cause of serious human disorders. Fifty years since a like statement would leave one upon debatable ground, to-day the premis is incontrovertible.

Carbon laden gaseous vapor, visible as smoke, is proof possible of incomplete combustion, and the proprietor who permits it is improvident, in that he allows steam producing matter to be voided, thereby increasing the cost of production. Any business man in a large city can furnish startling figures as to damage to property and merchandise; the respiration of tree, shrub and flower is impeded to such extent that it enters upon asthmatic decline; and the sun's ray, one of the greatest germicides known to science, is absorbed to such extent that tubercular infection shows an alarming increase, and catarrhal affection is rampant in every large industrial centre.

The indictment is specific, and upon every count has been proven beyond peradventure in the tribunal of scientific research and the realm of practical experience.

Coal smoke has been defined as "the volatile products of imperfect combustion, consisting mainly of finely divided carbon with oil and tarry vapor."

Lord Palmerston defined dirt from a health standpoint as "matter in the wrong place," and carbon in the atmosphere is matter in the wrong place.

Practically smokeless combustion is attained with anthracite fuel, the volatile component of which is quite low, but the supply is so limited that it it were used universally for industrial purposes, the fields would be depleted in a comparatively short time. We must therefore rely upon the bituminous article, which is high in volatile smoke producing ingredients. The tribute has been laid upon the choicest scientific and engineering talent of this continent, in efforts to evolve means whereby bituminous coals may be burned under conditions approximating perfect combustion, thereby largely contributing to industrial and social economics and incidentally abating smoke to the point of virtual elimination. I frame the statement in this form, because the desideratum is enhanced economy of production, to which smoke prevention is incidental. To this end, the United States Federal Government has established various stations under the supervision of highly trained engineers, who have conducted and recorded exhaustive experimental tests with all classes of fuel; have assembled data from a multitude of plants orperating under commercial conditions in different States of the Union; and have compiled, published and circulated results, which prove conclusively that objectionable smoke emission is unnecessary and wasteful. Posterity, to whom an unsullied atmosphere is bequeathed, will return thanks to the United States Government and honor the memory of Professors Wilson, Breckenridge and Randall, whose labor and ingenuity have so largely contributed to the solution of this difficult and complex problem.

That imperfect combustion is wasteful, is shown from the fact, that one pound of carbon uniting with oxygen and completely burned, furnishes 14,000 B.tu., while the same quantity not thoroughly consumed returns but 4,400 B.t.u. A Brtish Thermal Unit is the quantity of heat required to raise one pound of water by 1 degree F., when at its maxium density, i.e., from 39.1 degrees to 40.1 degrees Fah.

The term "Smoke Consumption" is a misnomer; the proper appelation is "Smoke Prevention." Carbon laden gas associating with atmospheric air, is what we recognize as smoke, and once this combination is effected we cannot hope to recover the combustible matter and burn it. Therefore, our effort is directed towards the complete combustion of the fuel elements in the fire-box, whereby the heat may be transferred to water in the boiler.

An awakened civic conscience, with a vigorous and sustained public opinion, is necessary to the promulgation and enforcement of smoke laws. Such laws should be simple, direct and enforcible. If we demand that which is unreasonable or unattainable, the courts will intervene and declare the enactment to be bad in law.

Smoke Ordinances.

I shall give for your information a summary giving the pith of the ordinances from various cities, cited under their municipal caption:

Detroit, Mich.—The emission of dense black or gray smoke is deemed and declared to be a public nuisance

Washington, D.C.—The emission of dense or thick black or gray smoke or cinders is deemed and declared to be a public nuisance.

St. Louis, Mo.—The emission or discharge of dense smoke is declared to be a public nuisance. The onus of proving that there is not a practicable device, appliance, means or method, whereby the discharge may be eliminated, is placed upon the defendant.

Chicago, Ill.—The emission of dense smoke is prohibited and declared to be a nuisance, except for a period of six minutes in any one hour, during which the fire-box is being cleaned out or a new fire being built therein.

Buffalo, N.Y.—The discharge of large quantities of smoke, soot, dust, gas, steam, or offensive odor, is prohibited, if it has a natural tendency to cause injury detriment, or annoyance to any person or persons, business or property.

Cleveland, Ohio.—Prohibits the emission of any dense smoke.

Cincinnati, Ohio.—The emission of smoke in such quantity or manner as to cause injury, annoyance, inconvenience or damage to the inhabitants of the city, or their property, health or physical comfort, is declared to be a public nuisance.

Minneapolis, Minn.—The emission of dense smoke is declared to be a public nuisance.

New York, N.Y.—The emission of cinders, dust, gas, steam, or offensive odor, and smoke, is prohibited.

Baltimore, Md.—The emission of black or dark gray smoke is prohibited for a period greater than six minutes in any one hour.

Milwaukee, Wis.—The emission of dense black or gray smoke prohibited for a period greater than six minutes in any hour.

Springfield, Mass.—Dark or dense gray smoke emitted for more than two

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* Property Commissioner, Toronto.

Profesor William Kent, formerly of Syracuse University, made the statement that if all boiler manufacturers would instal these units at least four feet above the grate surface, a tremendous stride would be made along smoke preventive lines.

Often times it is a very considerable problem to increase boiler capacity, and this holds true especially in the central manufacturing districts of large cities, where land is immensely valuable and structures are closely built. For many years boiler rooms "simply happened," and any corner which could not be put to other useful purpose, was allocated to the steam end of the plant.

Stoking.

Careless stoking is undoubtedly the most prolific cause, for with all the foregoing disabilities a careful fireman may largely overcome objectionable discharge. It has been rightly said that the best smoke preventive is an "intelligent, careful fireman." Upon the walls of every boiler room should be inscribed in striking characters the motto: FIRE LIGHT AND OFTEN. This, with sufficient air admission below and above the fire, will do much to minimize smoke discharge. The intelligent fireman, in the majority of instances, knows when to look for a heavy load, and has his fires prepared against the time of maximum demand. The retort is made, that it is exceedingly difficult to procure men of this class. This contains an element of truth, but on the other hand, if the wage paid is made sufficiently attractive, marked difficulty will not be experienced. The poorest investment in an industrial plant is a slovenly, careless stoker. Many good men, who otherwise would perform efficient service, are prevented from doing so by a multiplicity of duties which they are called upon to perform.

Mechanical Devices.

Many excellent mechanical devices have been designed for large plants, where the item of labor is a consideration. These give an approximately continuous feed of fuel, and the nearer we approach to this condition, the more closely we attain to perfect combustion.

Scores of cases may be cited, where expensive devices installed by reputable firms have altogether failed to perform the office required. I am glad to say that this does not hold good to-day to such extent as it did three years since. The competition in this line of business is exceptionally keen, and selling agents striving to increase their commissions, accepted contracts, which to-day would be unhesitatingly rejected by their engineering departments. A few years since it was merely a question of selling a stoker. To-day, before a responsible firm makes a proposition, it's engineers closely analyse existing plant conditions, and when an order is accepted, are prepared to stake their reputation and money upon the successful operation of the device.

I have dealt wholly with the question of industrial smoke. Another phase which is, at present, receiving attention from the majority of municipalities, is the emission from railway locomotives. Of necessity I have only touched upon the salient features of smoke abatement, and have been able to deal only superficially therewith.

Let me reiterate, that with an awakened civic conscience, a sustained public spirit, and a moderate law wisely enforced, smoke may be abated with profit to all.

MONTREAL OFFICE CHANGES.

Among the changes of offices premises which took place in Montreal on May 1st this year are:

The Allis-Chalmers-Bullock Co. have moved from the Commercial Union building to the Canadian Express Building.

The Kent Company, (refrigerating machinery) have also taken new offices in the Canadian Express building. They were formerly in the Coristine building.

Mussens, Ltd., have moved to 318 St. James St., where they now occupy the four floors of the building.

The Westinghouse sales offices have moved from the Commercial Union building to the Victoria building, where they now occupy the entire ground floor.

The Holden Co., Ltd., (railway supplies and pneumatic machinery) have moved to 354 St. James Street.

The Colonial Engineering Co., Ltd., have taken offices in the new Jacobs building in St. Catherine Street.

The Linde-British Refrigeration Co., Ltd., have moved to the building 37 St. Peter Street. Their offices occupy the ground floor, while the four floors and basement are to be devoted to stock and work rooms. They carry complete installations of their smaller machines and full renewal stock of their larger machines.

Chapman & Walker, of Toronto, have opened an office in the Coristine building. Rooms 427 and 428.

The Magnolia Metal Co., have moved to 223 St. Ambroise Street.

Babcock & Wilcox, Ltd., have moved from the Quebec Bank building to College Street, St. Henry.

QUANTITY AND COST OF BLEACHING POWDER FOR DISINFECTING.*

Bleaching powder is an impure commercial product manufactured in large quantities abroad by some of the earlier chemical methods, and at Niagara by modern electrolytic methods. Owing to the fact that in the latter case it is essentially a by-product of the much more important caustic soda industry, its present market price is very low, and in fact less than the cost of production on a small scale. Upon admixture with water it goes into solution only partially; a residue of carbonate of lime and an excess of free lime remaining in the tank as a white sludge. In practice it is desirable at large works to keep this mixture stirred up and to discharge the sludge with the solution; at smaller works economy indicates the use of the clear solution and the disposal of the lime sludge in a convenient manner.

To the layman one of the most striking features of this process is the relatively small amount of disinfectant necessary. For crude sewage an amount of so-called "available chlorin" equivalent to about five parts per million parts of sewage, which amounts to about 125 lbs. of bleaching powder per million gallons, suffices. Upon the present market price of $25 per ton or less, it will be seen that the cost of bleaching powder necessary will be in the neighborhood of $1.70 per million gallons of sewage disinfected. By the use of the quantity indicated, disinfection is accomplished within a very few minutes, and storage periods of not over thirty minutes are ample.

Sewage stronger than the average American sewage would require somewhat larger amounts than these indicated, but twice the quantity probably represents the maximum. For partially purified effluents, such as those resulting from trickling filters, lesser quantities are sufficient. At Baltimore three parts per million of available chlorin, or 75 lbs. of bleaching powder per million gallons were found effective in the disinfection of the trickling filter effluent. At Boston satisfactory disinfection of a similar effluent was accomplished through a period of six months by the application of three and a half parts of available chlorin. Effluents of a higher degree of purity can be disinfected with corresponding smaller amounts. The total cost of the processes, including interest charges and depreciation upon the necessary fixtures, labor and other items will range from $1 or less in the case of effluents to about $3 in the case of crude sewages.

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*Extract from a paper by Earle B. Phelps, Proceedings Engineers' Club of Philadelphia.

The Distribution of Power in Mills and Factories

The Introduction of Clutches has done a Great deal in Saving Power—By their use Machinery which is run only Occasianally may be Stopped when not in Use.

DURING the working hours, when the engine or other prime mover is in continuous motion, some of the driven machinery may be required to run all the time; all of it is presumably supposed to run some of the time; but not all of it can commonly be expected to run all the time.

The ordinary shipping belt is an entirely satisfactary arrangement for starting and stopping individual machines of comparatively light power requirements, and even heavier ones whose continuity of operation is only occasionally disturbed. But when larger power units—whether individual machines, groups of machines, or whole departments of a plant—frequently or even at longer intervals must be isolated as power users from the remainder of the system, then the instalation of a clutch will be found to save power.

These conditions, as well as any others wherein convenience of manipulation for any item or section of a system is a factor, are satisfied most readily, and sometimes only, by the use of the friction clutch in some form. For moderate powers, in cases where the periods of idleness are comparatively small, the pulley, sheave, sprocket or gear may be fitted to the sleeve of a clutch on the continuously moving shaft. Larger power units are properly cared for only by the quill, running in its own bearings, the shaft passing freely through its hollow centre. Where division of a line of shafting into successive sections will satisfy the conditions, the clutch coupling or cut-off clutch is properly used.

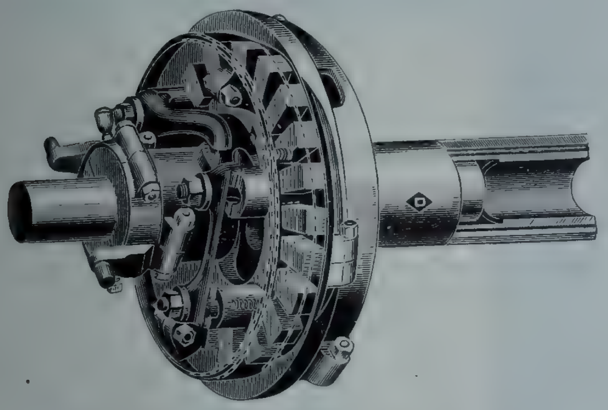


Fig. 1.—Split Friction Clutch, Dodge Mfg. Co., Toronto.

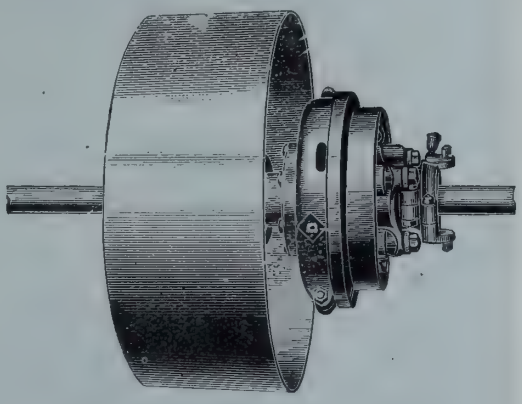


Fig. 2.—Split Friction Clutch, Dodge Mfg. Co., Toronto.

In Fig. 1 is shown a split friction clutch. Its principal feature is its great frictional power, which is secured by the very nature of its construction, consisting of a disc into which are driven hard maple blocks presenting end grain to inside and outside driving plates, and powerful levers for forcing the plates into contact with the wooden blocks. Thus power is transmitted to the clutch sleeve, or to the next shaft section if the clutch be used as a coupling.

Being split, the clutch is placed in position on the shaft without interference with the remainder of the equipment. Repairs and renewals are similarly facilitated. The split friction clutch is extensively used and is especially adapted for high speeds and severe duty, as in jackshaft requirements.

Fig. 2 shows a split friction clutch used in combination with an iron pulley.

Fig. 3 shows a solid friction clutch and cut-off coupling. It is used for light power and moderate speeds. This clutch is of the self-contained class, and exerts its full clamping or frictional power without moving either shaft or pulley. The multiple friction plates give a high aggregate pressure for driving purposes, with a comparatively low pressure between successive plates of the series. It is a most desirable clutch for countershafts where reverse motion is required, as it lends itself readily to use in duplex.

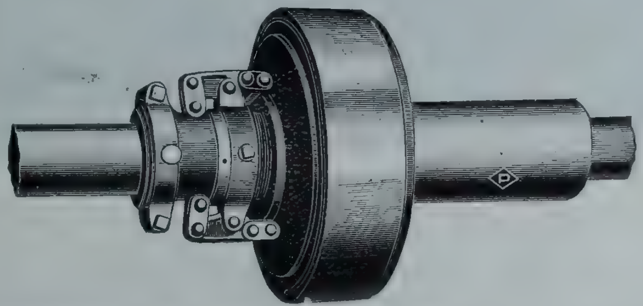


Fig. 3.—Solid Friction Clutch and Cut-Off Coupling, Dodge Mfg. Co., Toronto.

At the factory of the Dodge Mfg. Co.. Toronto, one department of the factory is devoted exclusively to the manufacture of friction clutches on an interchangeable basis. The sleeves are standardized for use with wood or iron pulleys, rope sheaves, gears, sprockets, etc. The use of these sleeves permits the changing the sizes of pulleys when desired.

MAKING IMITATION RUBBER.

The price of pure Para India rubber, which in 1903 was 88 cents per pound, rose last year to $2.25 per pound. This increase in price gives additional interest to the processes of regeneration of waste rubber and of the manufacture of substitutes. The regeneration of vulcanized India rubber consists in removing the sulphur, which was added in the process of vulcanization. The scrap rubber is assorted according to quality, and is treated either with sulphuric acid or with potash, for the purpose of destroying fibres of cloth, etc., and of removing the greater part of the sulphur. The material is then ground and washed. This regenerated India rubber is used only as an addition, in small proportions, to new rubber. Artificial or imitation rubber is made by methods which resemble the process of vulcanizing natural India rubber; for example, by treating linseed oil with sulphur or sulphur chloride.

DAVID K. McLAREN.

David K. (D. K.) McLaren, the president of D. K. McLaren, Limited, Montreal, is well and widely known in the leather belting trade. Born in Perth, Scotland, he came to this country in 1850 and immediately went into the leather business. He has been associated with leather all his life and in 1880 commenced the manufacture of leather belting in Montreal.

From a very small nucleus, Mr. McLaren has seen his business grow to such magnitude as necessitated the reorganization into a joint stock company in 1907. At this time, his sons, Messrs. W. F. and R. M. W., who have long been associated with the business, became vice-president and secretary and general manager respectively. The business gained new impetus under this change, and recently the company purchased a large block in St. James street where they will move as soon as the present tenants' leases expire. This increase has necessitated the opening of branches at St. John, N.B., Quebec, Toronto and Vancouver. Although well on in years, Mr. McLaren still takes a very active part in the management of the company's affairs and one will always find him on hand at the Craig St. office when in the city.

The business of the firm embraces all lines of mill supplies that pertain to belting. Besides their regular lines of slow process oak tanned leather belting they handle the Canadian output of Balata belting of one of the largest English houses. Clothing for carding machines is another of their lines and recently they acquired the Canadian agency for the Philips pressed steel pulley, a large stock of which they carry.

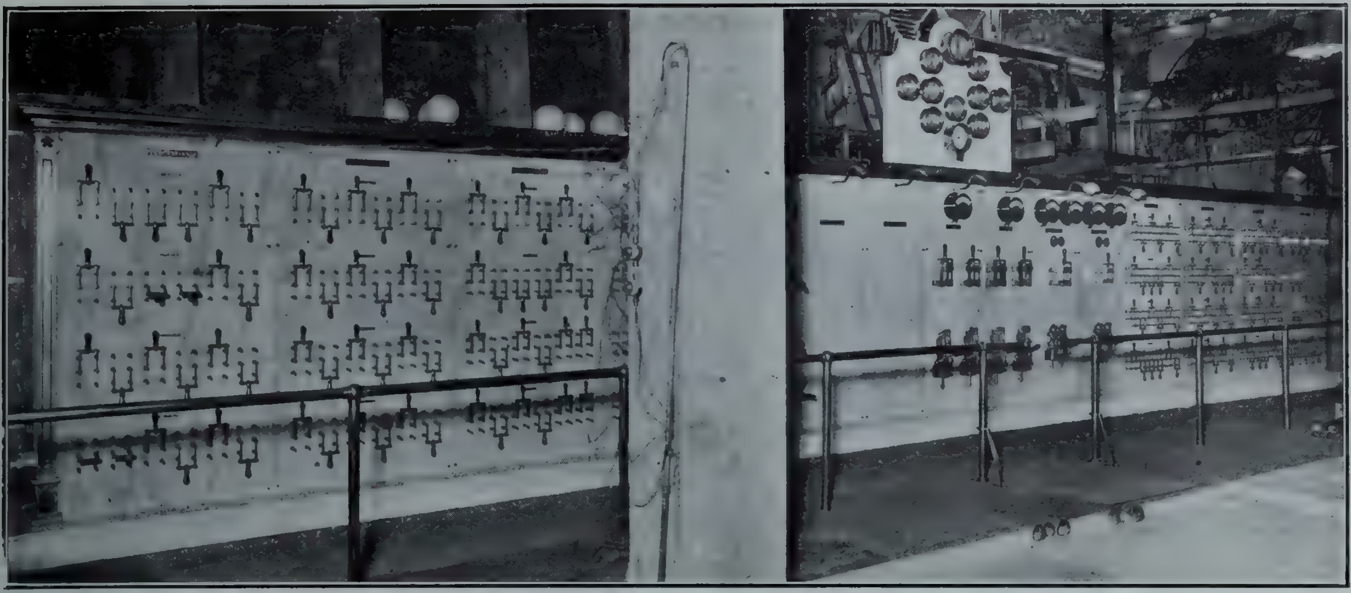
D. K. McLAREN.
D. K. McLaren, Limited, Montreal and Toronto.

ELECTRIC RAILWAY PRACTICE.

A number of questions on electrolysis were submitted by the chairman of the Electrolysis Committee in Chicago to the United States Bureau of Manufactures for investigation by American consuls in ten of the largest European cities. The questions were as follows: 1. The use of the track rails for the electric return circuit of street railway lines. 2. The permissible drop in potential over the return circuits of street rail way lines. 3. The maximum difference in potential between track rails used as return circuits and gas pipes, water pipes, or other metallic structures contiguous to the track. 4. Regulations or practices with reference to electrically connecting track rails to gas mains, water pipes, or other metallic sub-structures. A summary of the answers of the consuls in the cities referred to has just been published in the Daily Consular and Trade Reports. In all of the cities rails are used for the return circuit. The permissible drop in potential over street railway return circuits in London is 7 volts maximum; in Paris, 1 volt per kilometer, 5 volts maximum; in Vienna, 5 to 7 volts; St. Petersburg and Moscow, 1.5 volts in the city and 3 volts in the suburbs; Glasgow and Liverpool, 7 volts, and Christiania, 10 volts. The potential difference between track rails and contiguous pipes for London was pipes plus 1.4 volts and pipes —4.2 volts; Paris, average of 1 volt; Vienna maximum observed, 1 volt; Glasgow observed less than 1 volt; Liverpool maximum, 4.5 volts; Christiania maximum, about 5 volts. In London and Glasgow electrical connections between negative returns and contiguous pipes are permitted. The cities of Berlin and Brussels make no specific regulations regarding any of the last three questions.

TANNERS' TARIFF RESOLUTIONS.

At a meeting of the Tanners' section of the Board of Trade, Toronto, held recently, a resolution was passed protesting against the decrease in the duty on leather, and against any proposed reciprocity treaty between Canada and the United States in so far as manufactured goods are concerned. The resolution concluded:—"Be it therefore resolved, that the Tanners' section of the Board of Trade of the City of Toronto trust the Government will see their way at the very earliest moment, to replace our tariff on a 17½ per cent. basis, which we consider is as low as the best interests of all concerned will warrant, and that if at any future time changes are under consideration that will affect the tanning interests of Canada, they will give an opportunity to those who are vitally interested to express their position to the Government of that day."



Switchboard at The Robert Simpson Co., Toronto.

The Light and Power Equipment of the Robert Simpson Co.

General Description of Power Plant and Power Distribution Through the Building — Low Pressure Signal for Fire Protection Detailed.

By F. G. Stroud.

The Robert Simpson Co., of Toronto, have in their mammoth store an institution of which they may well be proud. The building, new and old section combined, is 310 feet long and 150 feet deep, and is six stories in height as well as a basement. On each floor there are from 80 to 100 arc and between 300 and 400 incandescent lamps, besides a large number of incandescent lamps for showcases and silent salesmen on the principal floors. All of the wiring for light and power purposes is installed in iron conduits. In the new part of the building the conduits are concealed, buried in the concrete during erection. In the old section of the store the conduits are necessarily exposed on the ceilings.

For lighting and power purposes 250 V. direct current is used. In all there are 600 arc lamps in the store, the order for which was equally divided between the Canadian General Electric Co. and the Adams Bagnall Co., of Cleveland. The arc lamps are all of the enclosed type, 5 amp. 250 V, and operate two in series.

To equalize the load on the conductors each floor is divided into 12 sections or units, each unit controlled from a panel board with the necessary switches and circuit fuses. Each panel board is fed independently from the main switch board in the engine room. On the seven floors this makes 84 panel boards for ordinary lighting purposes and five for exterior decoration. The latter comprises the row of 1,400 incandescent lamps encircling the building, just below the cornice.

From two junction boxes on the engine room wall, which can be seen high up at the back of the switchboard, Fig. 1, 105 1¼ inch conduit pipes are carried beneath the basement floor of the new building, rising between the supporting columns dividing the old and new buildings. Each pipe is branched off at its proper floor and carried along to its individual panel board. From the junction boxes on the engine room wall the pipes are carried down and along in the concrete floor to the back of the switchboard.

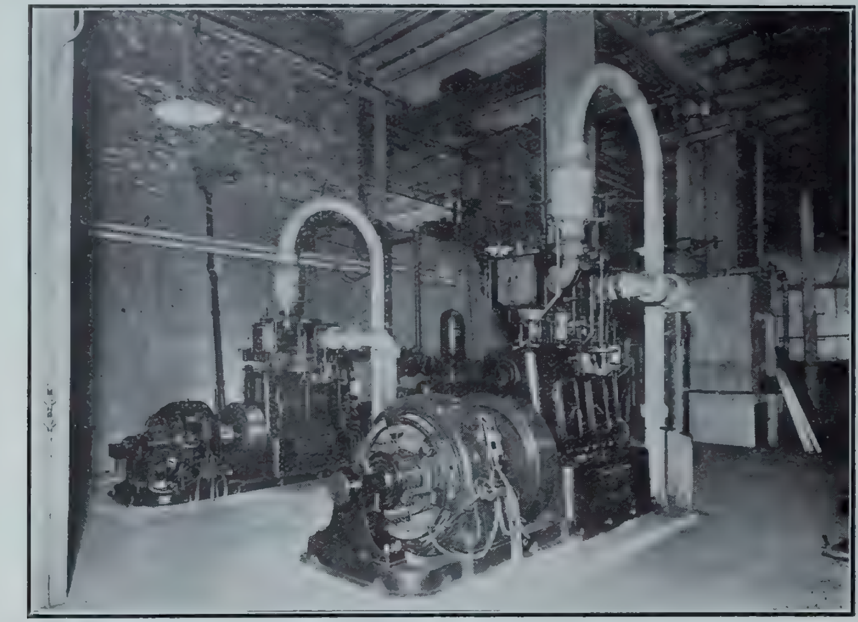
The engine and boiler rooms are located underneath James St., which runs alone the west side of the store. It is 80 ft. by 50 ft. wide.

The main switchboard, Fig. 1, is made from blue Vermont marble and is 42 ft. 6 inches long. In all there are 15 panels, one for each floor, one for decorations and special purposes, one power panel, to control the motors in the store, 2 panels are for Niagara power supply, two for the generators, while the two blank panels are for 800 kilowatt sets not yet installed.

The private supply and Nigara power having to be distinct, two separate sets of feeder bus bars are run at the back of the board and connected to double throw switches for the store lighting system. This Niagara power (500 V., 3 wire system) is brought through nine 1,000,000 C.M. cables to the meter panel at the back of the switchboard, and from there to the four 1,000 amp., S.P. condit circuit bceakers, where it is split into two 250 V. feeder bus bars. The current from the two generators connected in parallel, is conveyed through the D.P. condit circuit breakers to the other set of feeder bus bars. The store receives the greater portion of its supply from Niagara, about 2,500 amp. full load. From their own plant 600 amp. can be generated, normal load, which is sufficient to carry the light during the night, after business hours, and also acts in case of an emergency such as break down of Niagara power during the day. The switchboard operator can put any section of the store on to either service by means of the double throw switches in case of trouble.

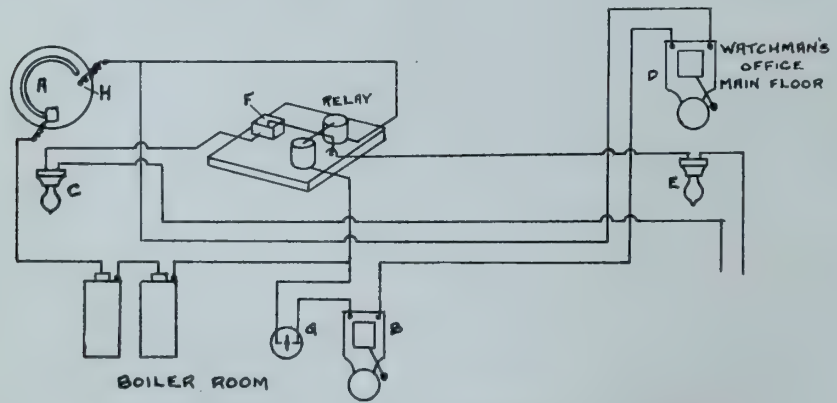
On the centre piece on top of the switch board are mounted the steam, water and sprinkler pressure gauges, and on top of each gauge a small pilot light is to be fitted in connection with the tell tale and electric alarm system. The accompanying diagram, Fig. 2, shows method of connections. A is a gauge with the dial removed ; C, a pilot lamp ; B, the engine-room alarm bell ; D, an alarm bell in watchman's office ; E, a pilot light in watchman's office ; H, an insulated contact post, and F, a switch contact which dips in a mercury cup.

If the steam pressure falls contact is made with H which energises the relay and dips the switch in the mercury cup and so lights lamp E on the gauge board and also lamp E in the watchman's office. The same current which puts the relay in action also rings bell B in the engine room and bell D in the watchman's office. When the bell rings it is the duty of the engine-room foreman to stop the ring from switch G, thereby notifying the watchman that the trouble is being attended to. The lamps, however, stay lit as long as the pressure remains low. When the pressure returns to normal the contact breaks at H and a tension spring on the armature of the relay breaks the contact at switch F. With the trouble adjusted the foreman puts switch G to the normal position again.



General View of Engine Room, Robt. Simpson Co., Toronto.

The two compound wound generators, Fig. 3, were manufactured and erected by the Canadian General Electric Co. One is a 100 kilowatt direct connected to a 150 h.p. vertical compound Robb-Armstrong engine; while the other, a 50 kilowatt machine is connected to a 75 h.p. engine.



Layout of Low Water Signal System, Robt. Simpson Co.

Between the two engines at the rear, can be seen the underwriters' fire pump, made by the Canada Foundry Co. This pump has a capacity of 1,000 gallons a minute for the sprinkler system, drawing from a 1,000,000 gallon concrete tank under the basement of the store. At the rear of the 100 kilowatt set is a 1,000 h.p. Cochrane water heater for supplying the kitchen and lavatories. The back of the boilers can also be partly seen.

There are three 250 h.p. Atlas type natural draught boilers, working at 200 pounds pressure. The boilers were built and erected by the Canada Foundry Co., and are fitted with green chain grates. Their feed pumps are of the Smart-Turner duplex type two Webster improved pumps handle the heating system.

There are seven standard plunger elevators in the store,—two freight and five passenger. The pump and tank equipment is placed in the basement of the engine-room under the switch board and consists of two 90 h.p. Marsh steam pumps, 2 pressure, and one storage tank. The store requires about 40 motors, used for various purposes, such as operating a dish washer in the kitchen, grinding coffee in the grocery, etc.

Every vestibule is equipped with a Sturtevant fan and steam coils operated by electric power; in fact no expense has been spared to make this store as efficient and comfortable as possible for its growing army of customers.

MANITOBA STATIONARY ENGINEERS' BOARD.

At a recent meeting of the cabinet ministers of the Manitoba government the following were appointed to constitute the board of examiners, to inquire into the fitness of applicants for the running and operating of stationary engines in Manitoba: W. R. Colquhoun, R. C. Buchanan and Robert Pride.

The appointing of such a board of examiners was authorized at the last session of the Manitoba legislature, with a view to lessening the number of accidents in the province, resulting from incompetent men handling engines. They will examine candidates as to their fitness, and if they fulfill the necessary requirements of the act, they will be given a license permitting them to operate stationery engines in this province. The act does not affect men who have been in the business of stationary engineer in the province for two years.

STEAM TURBINE IN MARINE PRACTICE.

Steam turbines are not the best prime movers for driving propeller shafts, because they are not sufficiently flexible and their greatest efficiency is obtained only when they are operating at speeds that are too high for the propellers. For this reason efforts have been made to introduce an efficient transmission gear between the turbine and the propeller shaft. At a recent meeting of the Society of Naval Architects and Marine Engineers, held in this city, a paper was read by Mr. W. L. R. Emmet on this subject, proposing the use of a combination electric drive. While the general idea is not new, Mr. Emmet presents some novel details. Twin screws would be used, each driven by an electric motor and a low-pressure turbine, the motor being energized by a generator connected to a high-pressure turbine. The low-pressure turbine would deliver three-fifths of the power when traveling at full speed, and at low speed would carry no load whatever. A proposition has been made to the government to equip one of the new battleships with this system.

REFRIGERATION DEPARTMENT

MANAGEMENT OF REFRIGERATING MACIHNERY.

By W. G. Walters.

I wish to describe the workings of a refrigeration system from an engineer's point of view and give as well some suggestions as to the care and management of the Linde system of refrigeration. A Linde refrigeration plant consists of the following three principal parts: (1) a compressor in which the gas is compressed, (2) a condenser in which the compression heat is abstracted and the compressed ammonia gas formed into a liquid, and (3) a refrigerator in which the liquid and anhydrous ammonia is allowed to evaporate under low pressure, thereby abstracting the heat from the surrounding substances.

If we start from the compressor where the ammonia gas is compressed to the pressure required for its liquefaction, say 150 lbs. per sq. in., the compressed but heated gas is delivered into sealed pipes called the condenser. In these pipes the compressed gas gets cooled by means of water surrounding the coils and after becoming sufficiently cooled, falls to the bottom of the coil in the form of liquid anhydrous ammonia (ammonia gas will liquify at a temperature of 62 degrees F.) From here the liquid ammonia passes through a regulating valve into other coils called the refrigerator.

The regulating valve is required in the first place to allow the pressure to be kept in the condenser and also to only allow as much ammonia to pass into the coils as can evaporate going through. When passing through the regulating valve the pressure is suddenly reduced from 150 lbs. to about 20 lbs. and in doing so, is reduced in temperature. After the ammonia has absorbed all the heat it requires to allow it to expand, it is drawn back to the compressor and again compressed. It is a continuous circuit first into the compressor, then to the condenser, from the condenser to the refrigerator, and back again to the compressor.

In regard to the compressor considerable care is necessary if we are to have high efficiency. Be it understood that an ammonia compressor has very little clearance in the cylinder, from 1-32 in. to 1-16 in., so that an engineeer has to work pretty close when adjusting the piston rod or reducing crank bearings. Another source of trouble is the piston rod stuffing box on compressor which is from 12 in. to 16 in. long. The piston rod is lubricated by a special oil. On the Linde machine that was built about ten years ago the oil for the piston rod is kept in a recess under the rod and is pumped into the gland by a small pump. It is supposed to run out of the gland back into the oil recess. Considerable of the oil is taken into the compressor and distributed through the system. This was the system that was attached to the plant that I have charge of. Now the Linde system employs what is called a rectifier to collect this oil, but in my case whether the packing in stuffing box was no good or the piston rod was worn, I got up against it. The rectifier would not handle the amount of oil that was taken into the compressor, therefore considerable oil was distributed throughout the system and in one pipe I had a blockade.

I use cotton packing in the compressor stuffing box and some of the fine cotton worn off the packing, scale of the pipes in the coils and some of this oil, made the ingredients that furnished me with considerable trouble and worry. To prevent this trouble I made a sight-feed lubricator on a large scale and piped the pump delivery to the lubricator. Since then I have had no trouble and have recovered over a barrel of oil that was laying in the system. There are a number of things in the running of a refrigerating plant that has not been touched upon; charging with ammonia, evacuation of air, air in condenser, regulation of the machine, retification, maintenance of compressor, water supply, etc. In my particular case the biggest difficulty that I have experienced is in connection with the water supply to the condenser. In another letter I will give you my experience in pumping from deep wells, and give some more details in connection with mechanical refrigeration.

REFRIGERATION PLANT KINKS.*

By William Nottberg.

The object of this paper is to give my fellow engineers and the owners of ice-plants, the benefit of the experience in repairing quickly at a time when ice is ice. To begin with, one day on an upright double acting ice machine, one of the cranks began to heat up. The plant had five ice machines running 50 r.p.m. We loosened it up a little but it knocked so bad we concluded to take it apart. We slacked off on all the expansion valves and after shutting down the machine, taking off the connecting rod, etc., wiping clean the pin and brasses, which, by the way, looked as bright as a dollar, we found the crank shaft was cracked around the corner of the fillet almost clear around. Now what? In June! and a broken crank shaft in our machine. We speeded up the four remaining machines to 60

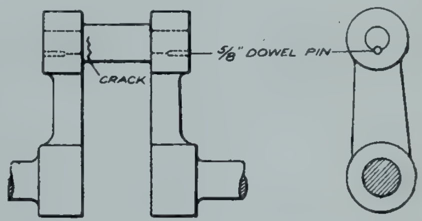


Fig. 1.—Cracked Crankpin and the Remedy.

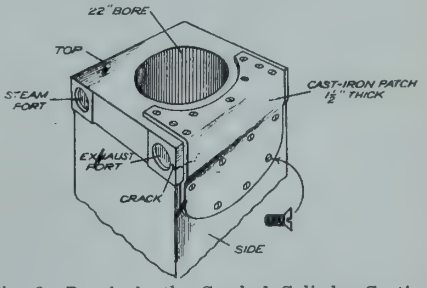


Fig. 2.—Repair in the Cracked Cylinder Casting.

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* Abstract of paper read before the Western Ice Manufacturers' Association.

r.p.m. each and nearly kept up the capacity, and I promise you the sound of eight dash-pots was "music to my ears." I heard it long after I was sitting on my front porch, several blocks away from the plant. We soon had the shaft out, took it to the machine shop and had it repaired as shown in Fig. 1.

It was a fine job and three days' shut down was all. We had lost not over five tons of ice per day on a 75-ton plant, or a total of fifteen tons. Total cost of the job was a small per cent. of what a new shaft would have cost, not including the delay, but after we had it running again I did not slack off the other four machines to 50 r.p.m. for several days and we actually made up our loss the following three or four days. We then put the machines to 50 r.p.m. and that shaft is running to-day. It broke 20 years ago. In repairing it the old pin was cut off; cheeks bored out one inch less in diameter, pin made and cheeks heated and pin shrunk in and riveted over.

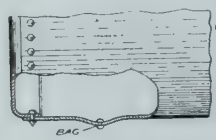

Fig. 3.—The Bag in the Boiler.

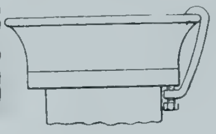

Fig. 4.—Clamps Used on the Compressor Head.

Cylinder Head Repair.

Another pleasant job I was called on one time was when the piston rod of a steam end on an ice machine broke and went through to top head breaking all the bolts and cracking the cast iron cylinder right through the valve port. It was an upright Corliss and at that time we had no autogenous welding apparatus. We repaired it as shown in Fig. 2. It made a good job and in about four days all was going again.

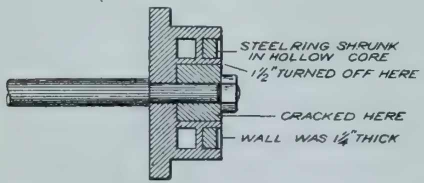

Fig. 5.—Steel Ring Shrunk on the Piston.

Another accident happened near by. One of my fellow engineers sent for me to come and see him and he had cold sweat on his forehead and his machine half speed and fire pulled from one of the horizontal boilers. We took a candle and set it at the end of a stick and examined the boiler and found same had a bag hanging down 1½ inches. We kept cold air rushing through tubes. After the boiler had sufficiently cooled down we ran cold water in and out until we could remove front man-head. The bag was as shown in Fig. 3.

Right in centre of bag it looked as if the shell was much thinner than any other place and the engineer insisted we should get a boiler maker and have him cut a piece about 12x14 inches and patch it. The owner of the plant asked me how long it would take to put the boiler in operation. I told him if his engineer would let me, I would have it back to work and ready for steam in two or three hours. We drilled a hole in the thin place, found shell was, at that place, 5-16-inch thick. More strength of metal than the seams and we put a rivet in hole and fixed up a charcoal fire and heated plate cherry red and drove it back in place as nice as you could think by 6 p.m. We put water in the boiler and soon had steam up and back to work. This was some four years ago and the boiler is doing work at the old stand to-day.

At one time I heard that "some where" a top compressor head got knocked off by a valve breaking and falling into the compressor. The unfortunate engineer called me up and asked me what I would do. I went to his plant as soon as possible and found that the studs had been broken and same pulled out and we had no time to lose as this was in August. What was the best and quickest way to hold that head down? We put clamps over it like this, plugged up the holes with cap screws, put a rubber and iron washer under head and fastened those clamps as shown in Fig. 4.

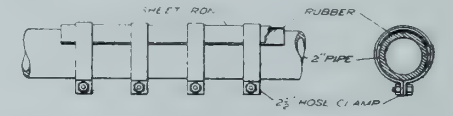

Fig. 6.—Hose Clamps for a Condenser Tube.

Flat iron 2x¾ inches, tapped it out for ¾ inches, set screws and we were going soon.

Ringing a Piston.

Another time on a 300-ton refrigerating machine with a horizontal steam engine, we noticed that on the forward stroke there was a sound like a water hammer in a steam pipe. It stopped when machine was at full speed, but every time we slacked it down, it pounded and, finally we took indicator cards, increased load and compression, decreased it, etc. Every time a visitor came through the plant we speeded up a little to kill that noise. After a whole day's indicating, we concluded to take the cylinder head off, that meant no ice for a day. Well, we did, and looked at the pston. It was all right. We took the piston all apart. It was one of the built-up type, and we found piston cracked in core, but not all the way through. A new piston from factory was 2,200 miles away and not much local foundry and machine shop. It takes three or four days if all goes well and casting is perfect. Now we took piston and piston rod out, left piston on rod and took it to machine shop and repaired it as shown in Fig. 5. We turned off 1½ inches and shrunk a 1½ inches thick by 6½ inches wide perfectly fitted machine steel ring around, and into hub. One day's work, and piston is running this minute. I considered it the quickest and most successful repair job for its size I had ever done.

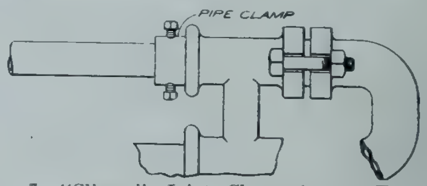

Fig. 7.—"Climax" Joint Clamp for an Emergency Repair.

Burst Condenser Pipe.

At another time a condenser pipe burst; the top and bottom valve was quickly shut off and all the ammonia from that particular section had leaked out. We had a piece ⅛ inch thick, pure gum with a piece of sheet iron, about 2 inches longer than the split, ready fastened it first with hay wire and then hose clamps, and in about one hour's time the job was done and section back in service. The patch looked like Fig. 6, and held the whole season.

One time I saw a leak on a double pipe condenser back of the fitting. We cut section out, pumped it empty and put a "Climax" pipe clamp against it as in Fig. 7, and I believe it was never taken off. We all know how quick we can stop a leak in an ice tank by putting bran or cement in it—always stop circulating pump during process until about some five hours after application.

One repair, or rather emergency, job I did for a friend of mine at one time was where the brass lining in boiler feed pump was badly cut. Pump had to be repacked almost daily. Finally I told my friend I would come over and see what could be done. I took a long chisel, split old bushing which was almost worn through in bottom. We took packing, real hard hydraulic, ⅛ inch size larger, and ran pump without brass lining. I don't think my friend ever put new lining in.

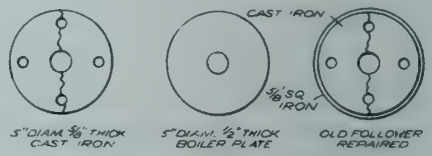

Fig. 8.—Pump Follower Makeshift.

Pump Repair.

At another plant my unlucky engineer reported that follower of piston on duplex water supply pump broke in two as shown in Fig. 8. He said without that pump he could not run one minute. We could not wait for a new casting to be made. We made a follower from a piece of $\frac{1}{2}$-inch thick boiler plate. It has never given any trouble. The next day we turned the follower down and shrunk a $\frac{5}{8}$-inch square iron ring on it and we now have an "extra."

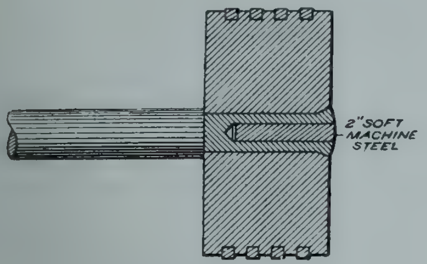

Fig. 9.—Tightening for a Loose Piston.

At another time a piston in a double acting 250-ton dry gas machine became loose on the rod. There was a nice tune in the machine on the up stroke. It seemed to be in the crank, then it sounded as if it hit the bottom head. In fact, its sound was everywhere and nowhere. I concluded that if piston was not loose, a piece of metal must have become lodged in $\frac{3}{8}$bottom and piston touched it every time after reaching bottom centre. The piston was removed. It was of the type that is shrunk on and then riveted. It was 20 inches in diameter and had a 4-inch piston rod with a shoulder like that in Fig. 9. I took it to the shop. We bored a 1 31.32-inch hole in centre and 10 inches deep. Into this hole we pressed or rather drove a piece of 2-inch soft machine steel with a 6-inch ram until we could drive no more. We riveted a new head on rod by taking a shallow cut off piston $\frac{1}{2}$ an inch around rod and that piston is running every day in the week, 24 hours.

Boiler Header Crack.

One plant had two B. W. boilers just big enough to operate the plant. When full capacity was called for, as is apt to be the case, something had to happen. A front header of cast iron in one of the boilers showed a crack, and water and steam was blowing out and running down the front and everybody was scared for fear header might let go at any time. I was called to the scene of trouble by my fellow engineer and he asked what to do. We pulled the fire, slacked ice machine down to half speed, put ice pullers on half rations, both pulling and paying and let water out when boiler was cooled down enough. We examined the crack in header and it looked like Fig. 10. Now the nearest place for a new header was Chicago. It would take four or five days at the least. Nothing beats trying, so we drilled two $\frac{3}{8}$-inch holes about two inches from each side of crack and tapped them out for 7-16-inch cap screws. We then took a piece of steel $\frac{1}{4}$-in. thick, $1\frac{1}{4}$-in. wide, heated same, hammered it until it fitted like a patch of rubber would fit by pressing it against the surface. After it fit perfectly, we marked off the holes, drilled them 1-16-inch closer together than holes in header, filled crack with "Leak No," smeared a little about like a coat of paint over the surface the patch was to occupy ; had it previously well cleaned off, of course, then we made steel patch red hot and laid it over crack as it had stretched enough to admit both cap screws. It was quickly in place and pulled up tight. Allowed it to cool and by the time the boiler had filled up to proper gauge, no leak in crack, boiler was fired up and put in service with only five hours' delay and full capacity restored.

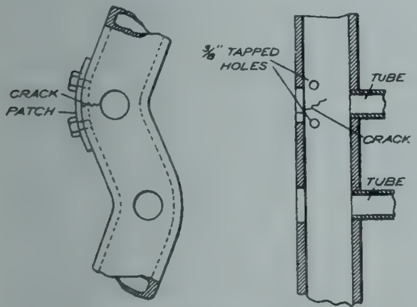

Fig. 10.—The Cracked Header Made Good.

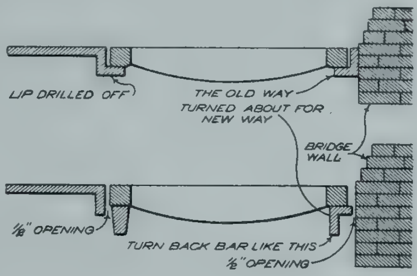

Fig. 11.—Old and New Grate Support.

At another time, and this happened to me at my plant and in the middle of the summer some ten years ago on one boiler, the grates fell out, and as I had all the brickwork overhauled during the past winter, I could not account for it. By closer examination I found the fronts of boilers all bulged out. I knew I allowed for expansion of grate bars and I cloncluded, as I could spare boiler long enough, to find the cause and make it right before I would replace grates as they were formerly. I found those grates which had not fallen out were so tight that they had to be driven out. I found that ashes and cinders had lodged on ends of grates and cleaning hoe had forced more in all the time at both ends when clinkers were pulled out and that was the reason. Fig. 11 shows the way grate bars were supported. Now I drilled off the whole front front lip and put in front a straight cast iron bar full width of boilers, used centre support and turned back bar like this. I allowed $\frac{1}{2}$-inch from bridge wall, forced fronts back into place and had no trouble from that source and we did this to all eight boilers.

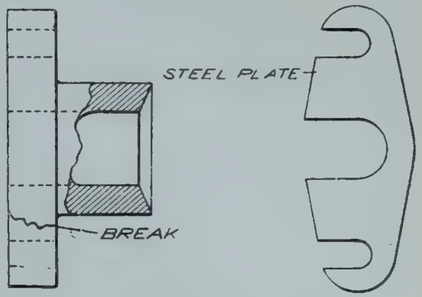

Fig. 12.—To Hold a Broken Pump Gland.

I also think a good many of our engineers have put plates in front of stuffing box gland when the fireman had pulled up too hard and broke gland as shown in Fig. 12. To remedy it we put a steel plate in front.

To put an extension on a foundation bolt when it broke off right below cast iron bed plate, we repaired it by drilling into the bolt as in Fig. 13. A $1\frac{1}{2}$-inch bolt broken off will only cause that much more strain on the balance of the foundation bolts and nobody knows when they will give away. We drilled it for a 1-inch bolt about $2\frac{1}{2}$ inches deep, made a piece 1-inch, mach$\frac{1}{4}$ine steel, put a heavy steel washer on top and uulled it up. When we have time we make a nut which has same size outside as a $1\frac{1}{2}$-inch and tape it out for 1-inch and we are secure, at least to the amount of a 1-inch bolt.

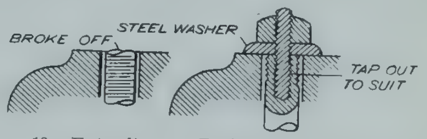

Fig. 13.—Extending a Broken Foundation Bolt.

An electric lighting plant in Nebraska is manufacturing ice as a by-product. The exhaust steam of the plant, which would otherwise go to waste, is utilized in the ammonia absorption process of ice manufacture, and also for distilling water from which the ice is made. This venture, we are informed, has proved a very profitable one for the lighting company, and might be copied to advantage by other plants similarly situated.

To find the horsepower of a gasoline engine, single-acting, 4-cylinder and 4-cycle, multiply the piston speed in feet per minute by the square of the cylinder diameter in inches and divide by 670.

PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

EXPLOSIONS IN FLOUR MILLS.

Explosions are often caused in flour mills and breweries by nails or other iron particles that find their way in the grain, and which when they strike the steel rolls of the mills produce sparks and ignite the finely pulverized material about them. Recently a large malting concern that had been troubled by many such explosions installed a set of electro-magnets over which the grain is passed before being prepared for shipment to the breweries. All iron particles in the grain are thus picked up by the magnets and 800 to 1,000 bushels of grain are cleaned per hour. When the magnets have collected a large amount of metal, they are swung to one side, de-energized, and swept clean of any particles adhering to them by residual magnetism. Since the installation of these magnets, there have been no explosions in the mills.

COST OF INSTALING WATER METERS.

A total of 1,617 water meters were installed in private residences by the Water Department of the District of Columbia during the fiscal year ending June 30, 1909. The work was extremely scattered and as a consequence the cost of installation was necessarily increased. The following was the average cost of installing a meter :

Meter	$8.50
Material	5.00
Labor	2.44
Total	15.94

The force engaged in the installation was as follows : One foreman, one plumber, five laborers, one 2-horse wagon and one 1-horse wagon. As the foreman also has charge of taking out and resetting meters for test and repairs and repairs to service pipes, only half of his time and the cost of the horse and wagon used by him is properly charged to installation. The total number of meters in service is 14,579, and the average annual cost per meter for maintenance is 26 cts.—Engineering Contracting.

TUNGSTEN FILAMENTS.

Tungsten filaments are commonly made by mixing the metal in a paste that is then extruded in the form of a filament, after which the paste is expelled and the particles of metal are welded together by an electric current. This complicated method of forming the filaments is due to the fact that tungsten is not sufficiently ductile to be drawn out into fine filaments. An English concern has just discovered a method of producing drawn filaments of tungsten, and the General Electric Co. has also just announced the discovery of a method by which tungsten may be rendered sufficiently ductile to permit of its being drawn into fine wires. The drawn tungsten filament is stronger than the filament made by the "sintering" process.

HORSE POWER.

James Watt established the term "Horse Power" in order that he might have some basis of comparison of the power developed by his engines. He measured the work done by a heavy London draft horse of the Clydesdale or similar variety during short intervals by observing the weight it could lift against gravity, the horse walking on the ground and pulling horizontally on a rope led through pulleys, so that the weight rose vertically.

NOTICE TO SUBSCRIBERS

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We should also be notified at once of any change of address, giving both old and new addresses.

The unit horse power, so established, was 550 foot-pounds of work per second, or 33,000 foot-pounds a minute ; that is, 33,000 pounds raised one foot in a minute, 330 pounds raised 100 feet, or 1 pound raised 33,000 feet a minute. But whereas few horses could do that amount of work for more than a few seconds together, a one-horse-power engine will go on producing that amount of work indefinitely so long as it is supplied with steam.

OIL IN BOILERS.

By James E. Noble.

Some days ago I received circulars from a firm describing a crude oil boiler compound. I am against this form of compound. Neither do I favor coal oil as a scale preventor or remover, I have stated my views on this subject in the Canadian and United States engineering papers, but there are a large number of engineers in this city and in other cities of Ontario who think that coal or crude oil is the acme of perfection for this class of work, even well-known authors in some cases recommended their use. Perhaps the experience of Mr. Rhul may interest your readers.

Mr. Rhul is doubtless known to many readers as a practical engineer. He says that no matter what success others may have had along the lines described above that his experience with crude or kerosene oil has always been a complete failure. The reason is not hard to find, kerosene is volatile at about 150 degrees F., while steam in a boiler at 90 pounds would be near 300 degrees F.; therefore the oil if fed into the boiler under high pressure, instantly flashes into gas and is carried away with the steam. In plants having an extra boiler, where each may be cut out, cleaned and dried, if the interior is then saturated with coal oil, and if the boiler remains idle for some time, good results may be obtained with the coal oil treatment in some cases.

He also claims that he had an interesting experience several years ago as follows. He was asked to take charge of a small electric light plant, the manager said they had good machinery in the plant, but it was neglected, on examining things he found everything erected and arranged properly, and started in. The fireman told him on the start that the boiler could outdo any other boiler in the country, as a foamer, in fact he was ready to take his oath that it would foam before the engine was started; that after a six-month run new tubes were needed, that the engine cylinder would cut and had to be rebored often, that the engine cylinder had been rebored, and a new valve put in a short time ago, that the boiler had been reflued four months ago, but that they were again badly scaled.

The pressure generally carried was 110 lbs. Mr. Rhul thought this too much, but was told that things could not be kept going on anything less, he was also informed that the safety valve had not blown for three months, and whenever it did open in the past it would remain open until steam was out of the boiler. He was in a quandary what to do, it being then time to start, and, not knowing what condition the valve was in, he would not monkey with it that evening, with steam up, while to cool the boiler down and leave the town without light would have brought loads of trouble to the new engineer, so he let things go until morning, and kept a close watch on the gauge and fireman that night.

In the morning he let steam down and took the valve apart and found the seat covered with an oily wax, which would not let it seat properly, he assumed the cylinder oil to be the cause of this wax, the feed water being heated by the exhaust in an open heater. After cleaning and grinding the valve it worked O.K. for about a week, when it began to leak, he raised it to let the steam blow out anything that might have lodged there, but this only made matters worse.

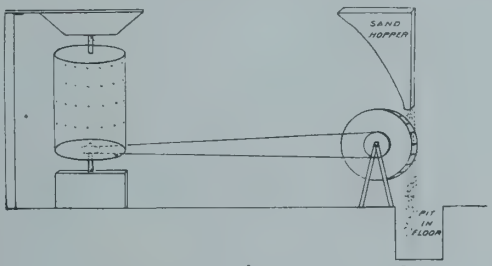
Soon after this the boiler was cleaned, and it was a daisy job, the shell above the water line was covered with a thick coat of tar or scum, and the tubes at and near the back head scaled so badly that there was hardly any water space between them. He thought that by using more of the scale compound (which had a high sounding name and was guaranteed to take scale off anything from a boiler to a fish), things might improve. The directions sent with it said if the boiler was badly scaled to throw in a half gallon of compound for each 100 h.p. every time the boiler was filled, besides feeding it regularly with the feed water. He put in one gallon while slowly filling the boiler, and the next night he thought the old boy himself had left his home below and taken up quarters in the boiler.

It now dawned upon him that the compound was the cause of all the misery, and he resolved right then and there to use no more of it. He told this to the manager, who disagreed with him, stating that the compound had been used around there for about six years. After some trouble the manager was induced to order some "well known to be good" compound, and after using it for some time things began to look different. The valves were all cleaned and fixed up and a good saving of fuel was shown until Mr. Ruhl left the plant about a year after, he had no more trouble with foaming boilers and the working steam pressure was reduced to 90 lbs.

While they used petroleum a man was kept busy calking seams and tightening joints, while after discontinuing the oil, the joints once tight remained so. While coal oil has not all the disadvantages enumerated in the foregoing, yet its action on seams and connections is somewhat the same and for that reason alone it appears poor policy to use it. Mr. Ruhl visited the plant shortly before making the above statements and he found they had the same tubes in the boiler that were in when he took charge of the plant, and the secretary of the firm assured that that never since they operated the plant had their fuel and repair bill been so low. Perhaps some of your readers have had experience with crude oil compound, and if so, it would be interesting and instructive to get their experience.

SAND AS A MOTIVE POWER.

The accompanying illustration shows sand used as a motive power, connected by a sewing machine belt to anything when it is desired to put it in motion. To prepare the apparatus for use, make a sheet iron hopper about 10x30 inches by 30 inches deep, the spout about 1/8 inch; make a wheel from tin, about 14 inches in diameter, similar to a waterwheel in a mill, and solder a small ring (wired) half-inch wide on side for belt, and connect to anything you wish to put in motion.



Mechanical Device Run by Sand.

Fill the hopper with very fine sand, previously well dried, and arrange for easy return of the sand to the hopper. The sand will keep the wheel in motion for half a day, then, by returning the used sand to the hopper the wheel can be kept running continuously. Sand is often used as a motive power, applied in the manner described, in stores for revolving displays.

USES FOR ELECTRICITY.

By way of educating the people in regard to electricity in its numerous applications to domestic and general power purposes, a municipal electric plant manager tells of the following things which one kilowatt-hour of electricity will do :

Saw 300 ft. of timber (deal).
Clean 5,000 knives.
Keep your feet warm for 5 hours.
Clean 75 pairs of boots.
Clip 5 horses.
Run an electric clock for 10 years.
Iron 30 silk hats.
Light 3,000 cigars.
Knead 8 sacks of flour into dough.
Fill and cork 250 dozen pint bottles.
Run an electric piano for 10 hours.
Lift 3½ tons 75½ ft. in 4 minutes.
Cook 15 chops in 15 minutes.
Give you 3 light Turkish baths.
Keep you warm in bed for 32 hours.
Keep your breakfast warm lor 5 hours.
Run your sewing machine for 21 hours.
Keep four domestic irons in use for an hour.
Boil 9 kettles, each holding 2 pints of water.
Run a small ventilating fan for 21 hours.
Run a large ventilating fan for six hours.
Carry your dinner upstairs every day for a week.
Warm your shaving water every morning for a month.
Run a plate-polishing machine for 21 hours.
Supply all the air required by an ordinary church organ for one service.
Pump 100 gallons of water or other liquid to a height of 25 ft.
Warm all the beds in the house, by a warming pan, for a fortnight.
Give you a fire in your bedroom for an hour while you are dressing or undressing.
Carry you 30 times from the bottom of the house to the top, 80 feet each journey.

STEAM, AIR AND ELECTRICAL TRANSMISSION.

At the Canadian Locomotive Works, Kingston, all the power, steam, air and electric are generated in a central power plant. Steam is generated in three 250 h.p. vertical boilers, steam being required in the forge shop for the power hammers.

Transmitting Power at Canadian Locomotive Works.

The engines are Belliss & Morcom installed by Laurie & Lamb, one being 350 b.h.p. and the smaller 145 b.h.p. These are connected to Canadian Westinghouse generators of 250 and 100 k.w. capacity.

One air compressor is an Ingersoll-Sergeant built by the Allis-Chalmers-Bullock Co. having a capacity of 444 cubic feet of free air per minute. The second having a capacity of 1,209 cu. ft. free air per minute was built by the Canadian Rand Co.

Power from the central power plant is carried in the manner shown in the illustration to the shops where the power is used. Inside the long wooden house are the steam and air pipes. The steam is 150 lbs. at the boilers, but of course the pressure is somewhat lower than this when it reaches the steam hammers.

The exhaust steam pipes are also included in the housing which is supported by a structural steel trestle, which also carries the electric wires shown in the illustration above the housings.

All heating is done by direct radiation except in the machine shop, where a fan blower, driven by an electric motor, has been installed. All steam for heating is distributed at low pressure, exhaust steam being used when ever possible. The water of condensation flows by gravity to three receivers placed in pits below floor level, and is returned to the boiler plant by Bundy pumping traps.

The power distribution is at 240 volts on a two-wire system, while the lighting is taken care of by separate three-wire circuits—240—120 volts.

DON'TS FOR ENGINEERS.

By James E. Noble.

I noticed some dont's for engineers in a trade paper recently. I imagine some of the following are original. Personally I have never seen many of them in print.

1. Don't put a valve on the water column connections. It is much easier to draw your fire and empty the boiler to make repairs then it is to close two valves.

2. Don't fail to have a valve between the boiler and safety valve. When the safety valve opens the other valve can be closed and thus stop the disagreeable noise of the escaping steam.

3. Don't allow the water to get any lower then the top of the glass. This is an easy way of getting water carried over into the engine cylinder which may require washing out.

4. Don't clean the boiler out oftener than once a year. You may get a bagged or burned boiler shell and use a lot more fuel by following this advice, but what is the odds, it is only your own reputation as an engineer or a slacker that is in question, and by refusing to keep your steam boiler in proper order folks will know which of the two you are.

5. Don't keep any polished or finished surfaces clean. It is much better to have a dirty, greasy, rusty lot of apparatus than to lower your engineering dignity by doing any cleaning up.

6. Don't fail to keep about half a plug of chewing tobacco in your mouth at all times. It improves an engineer's appearance greatly to have tobacco juice mixed with other foreign matter all over his face.

7. Don't fail to let a stream of foul oaths ripple like a perpetual fountain from your mouth whenever a stranger asks what appears to you a foolish question. It will give yourself and others a very poor opinion of your ability if you act like a gentleman.

8. Don't insult a visitor if he expectorates on the floor. Just tell him to use the wall or the ceiling as you wish to keep the floor clean.

The following are a few of H. E. Woods "Dont's" with additions and alterations. Follow them.

Don't forget that the careful and skilful fireman is a good smoke preventer, but a properly constructed furnace is a necessity for smokeless firing.

Don't forget that more importance is to be placed on the water than on the fire, although it is a mighty big problem to get steam on a boiler if either is absent.

Don't run away with the idea that you know it all about your steam engine. There is only one man knows it all. Modesty prevents me mentioning his name.

Don't leave standing water in pipes exposed to cold weather, although it bothers me to tell you how to leave running water in one place.

Don't neglect the cylinder head bolt nuts, keep them all tight.

Don't fail to keep water in the ash-pit.

Don't let steam drop, but drop your grouching.

Don't fail to improve the appearance of the Power House office by keeping "The Power House" on your desk.

EVAPORATION FROM WATER SURFACES.

Mr. Sidney R. Lowcock in a paper read before the Association of Water Engineers, London, gives the following formula for evaporation from water surfaces,

E equals 0.0001254 md

in which

E equals evaporation in inches.

m equals mean maximum sun temperature (Fahr.)

d equals duration of sunshine in hours.

This formula may be true only for England where his experiments were made and gives results for the whole year. It gives a result rather too high for the winter months and low for the summer months. The author believes that radiant heat has a far greater effect upon evaporation than heat transmitted by contact; therefore evaporation records from tanks will apply to reservoirs.

BURNING REFUSE.

In the borough of Blackpool, England, for the year ending March 31st, 1909, there were 17,969 tons of house and trades refuse disposed of at the corporation refuse destructor (incinerator). The net cost was 33 cts. per ton, for actual operating costs, not including interest and sinking fund repayments on capital.

The returns from sale of products were as follows:

Clinkers and screened ashes at from 12 cts. to 36 cts. per ton	$ 945.60
Mortar and ground oyster shells at from 96 cts. per ton	1,800.00
Scrap iron and old tins in compressed toles at $3.60 per ton.	192.00
Fish manure at $23.40 per ton..	1,387.20
Electric current	350.40
Sundries	28.80
Total	$4,704.00

Equal to a credit of 26 cts. per ton on the refuse burnt.

METERING SYSTEM.

Your attention is called to the saving made by metering the system throughout. At the rate our pumpage has increased each year, we would have pumped 411 million gallons, or 101 million gallons more than during the year 1906, which would have necessitated an additional engine man and fireman. Although we have been but a few months 100 p.c. metered (270 meters having been set since January 1, 1907), and the minimum rates made $1.00 less than the corresponding flat rates, we are able to give the following results:

Consumption decreased 38,897,373 gallons.

Water rents increased	$ 168.97
Coal saved	308.85
Packing saved	27.01
Oil and waste saved	48.39
Night attendance saved	1,200.00
Total saved not including additional deterioration	$1,753.22

—Extract from Superintendent's Report Canandaigua Water Dept., Canandaigua, N.Y., Mr. G. R. Ellis, Supt.

Always bear in mind to clean out a boiler thoroughly after doing any hammering on it, as scale may have been dislodged and have dropped down on the fire sheet. Bags and serious ruptures have resulted from neglect of this precaution.

LAMINATED CONSTRUCTION IN LEATHER BELTING.

By A. Eugene Michel.

Economy in transmitting power by belted drives depends first of all upon flexibility of the belting and smoothness of its surface. If the belt is stiff and hard, either internally or on the contact surface, it cannot be expected to wrap around the pulleys closely as it must to prevent slip.

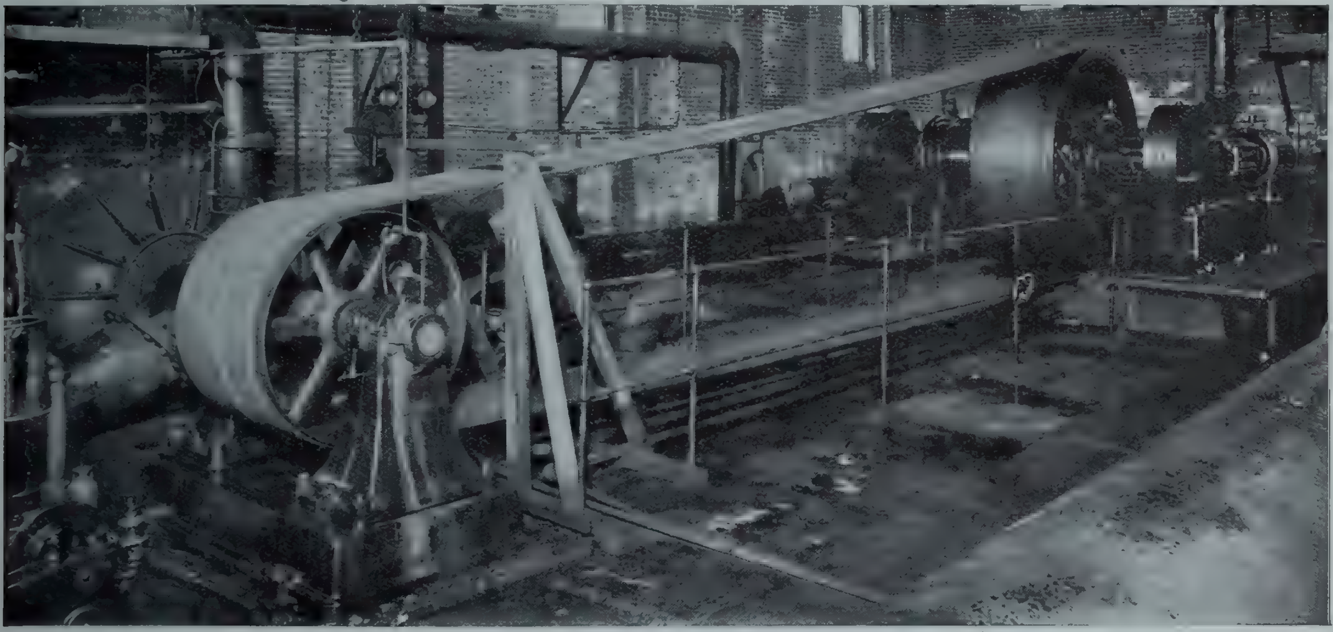
Surface smoothness in a multi-lap belt is dependent upon placing the grain or hair side of the leather to the outside and in an ordinary single belt by placing this next to the pulley. Yet the grain surface is the weakest part of the leather, being the first to be injured by improper tannage, the first that will burn from slippage of a belt on its pulleys, and the part that is likely to be ripped off in patches by sticky belt dressing.

The steady pounding which this surface naturally receives with every pulley contact tends to make it hard and brittle until as the amount of slip increases, the outside leather burns and leaves the interior of the belt open to gradual deterioration.

The fibres of leather are mostly parallel to the surface, and when brought into sidewise contact with the pulley as they must be in ordinary belting, the effect might well be compared to that of daily traffic on wood paving blocks laid with grain parallel to the street. In the latter instance, the wood would splinter to destruction in no time, but when placed to receive the blows against the ends of the fibres, the continual pounding does no damage. Similarly a butcher's block with the grain parallel to the top would be ruined in a hurry. The fibre in belting are affected or rather unaffected in much the same way when the pressure comes end-on. This is the condition which is brought about in laminated belting. The leather strips or laminations, all of equal cross section, are bound side by side without cement and so placed that the cut edge of the leather forms the belt surface. The leather is long lived and very flexible when so placed. By reason of the fibres being able to retain their natural dense interwoven position, they seat themselves firmly against the pulley surface, and permit the belt to transmit a far larger percentage of the power.

The advantages of bringing the cut edge of the leather into contact with the pulley are strikingly shown by an experience of the Standard Oil Co. with one of the belts in their Eagle plant at Jersey City. In this plant, which is their largest refinery of lubricating oils, the condenser water is circulated by a 16,000,000 gallon centrifugal pump, which in turn is belt driven from a 500 h.p. Fleming-Harrisburg engine. The driving pulley is 90 inches in diameter, the driver 42 inches and the distance between centres is 28 feet, 2 inches.

The drive was equipped with an Albeco Laminated Belt made by the American Laminated Belting Co., of New York. This drive is shown in the illustration. The belt in 28 inches wide, and equivalent in thickness to a three-ply lapped belt. The results are of more than passing interest. The power loss from belt slip is hardly perceptible. The pump can be operated with as low as 65 pounds of steam. The laminated belt has never been taken up, nor has it required other attention. It has never deviated more than one-fourth inch from its true position on the pulleys and its even motion has been the source of much comment.



Instalation of Laminated Leather Belting.

Heating surface of the tubes of a boiler is found by multiplying the total tube length in feet by 0.523 for 2-in. tubes, 0.654 for 2.5-in., 0.785 for 3-in., 0.916 for 3.5-in. and 1.047 for 4-in.

When observing the glass water gage while the boiler is working, note particularly whether the water in the glass is stationary or not. If the water level does not fluctuate, it is an infallible sign that the gage is out of order. Test the gage and water column immediately, and if draining them fails to clear, the boiler should be shut down until the apparatus for indicating the water level has been repaired.

Before breaking any steam pipe joints to make repairs, or to renew gaskets, etc., the dead section should be well drained. Workmen have been scalded when breaking joints due to some pressure still remaining in the line after the main valves were closed. Draw the pipes and avoid a similar injury.

Stop valves should never be located in a position that will permit a head of water to accumulate on the seats when the boilers are idle.

A 22-inch double-leather belt was installed at the Union Mills, Brooklyn, in 1876, to operate a main drive where it was called upon to transmit 100 horse power. This belt is still operating in as good condition apparently as when it was installed.

Correspondence

Discussion on Previous Articles
Remuneration for Useful Ideas

REMOVING BOILER TUBE.

The manner of taking tubes out of a boiler depends upon both the type of boiler and provision made by manufacturer.

"Subscriber" is probably using either a locomotive type or a return tubular boiler.

Some have hand-holes or wash-out plugs at bottom of tube sheets.

Others have larger holes in front tube sheets than in fire-box sheets..

This last arrangement requires that the tubes be swaged down on fire-box end to enter the smaller holes of that sheet, or that a copper ferrule be put on tube in front end sheet.

In the return tubular type, there are generally hand-holes in tube sheets of each end.

The method mostly followed is to cut the heads of the tubes at one end, then drive the tube through six or eight inches, with a round bar the same diameter as the outside of tube.

When tube is loosened up and will not come out easily, cut off the end and push it back into the boiler so that it may drop to bottom of barrel and be taken out at hand-hole.

Another method is to cut off tube with an internal tube cutter or other tools, inside the sheets at each end. This will allow tube to drop to bottom and can be easily removed through hand-hole.

The ends of the tubes have to be then split out of tube sheet, which is liable to damage sheet more or less.

When tubes are removed, see that all scale and dirt is chipped and cleaned out of boiler and that all stays are in good order.

Use a smooth half-round file to remove all burrs around holes in tube sheets. Great care should be taken to see that the flue sheets are clean.

Measure for length to cut tubes by using an iron rod or long strip of wood.

Try this rod in holes in different parts of tube sheet.

It may be necessary to cut some tubes longer than others, as the tube sheets are often not square with each other.

Cut the tubes the required length, allowing for heading.

Anneal the ends of tubes by heating to a dull red and allowing them to cool in slacked lime.

Clean ends of tubes with an old file and insert in boiler, beginning at top rim.

When flue is placed, drive a plug into one end to expand and hold the flue in the tube sheet while the other end is being expanded.

One form of expanded consists of a series of small rollers in a cage with a tapered spindle in centre.

This spindle is driven in, which expands the rollers and at the same time these rollers are rotated inside of flue, which thus rolls the flue so that it expands and forms a tight joint with sheet.

Put all tubes in and roll both ends. Then head both ends up tight to flue sheet, which stays the sheets and keeps the ends of flues from becoming overheated.

The heading tool is almost six inches long, made of seven-eighths hexazon steel, with a curved lip, offset to fit the head and a bent toe extended to guide the tool. No preparation is used on end of tubes, but care in cleaning the ends of tubes should be taken. This work requires a first-class boiler-maker.

At the price of boiler tubes it would not only be dangerous, but also very expensive, to allow anyone but an experienced man to re-tube a boiler.

J. DOUGHERTY.

EXPANDING AND BEADING TUBES.

I noticed in a recent issue of The Power House that one of our brother engineers was asking for information as to repairing leaky flues, or tubes, so I thought a few remarks on this subject would be acceptable :

Leaky flues should be fixed the first time the boiler is cool, as soon as the indicator is dead on the zero pin on the steam gauge. Then proceed as follows : If the leaks be only slight ones, they may be stopped by simply using an ordinary beading tool. To do this clean the end of the tube, and the tube sheet, and place the long or guiding end of the tool within the tube. Use a small hammer, and with light blows bead the tube all around, moving the tool slightly at each blow. The beading tool may be used when there is water in the boiler, but care must be taken to use only very light blows of the hammer or the concussion will be transmitted by the water and loosen other tubes. Having water in the boiler when beading the tubes has the advantage of showing the leaks, so that it may be known when the tube is tight. If the leaks be more serious, it will be necessary to use an expander. The expander requires considerable care and some experience to use, and in the hands of a novice or an inexperienced or careless workman, may cause great damage to the boiler by distorting the flue sheet, or rolling the tubes thin and worthless.

In using a roller expander, place the flange against the tube sheet and drive the pin in with a few light blows. Then turn it back and forth with a wrench until it becomes loose. Drive the pin in again and use the wrench, and repeat the operation several times.

The roller expander may be used when there is water in the boiler. If a spring or plug expander be used, be sure in the first place that it is the right size, and is made to fit the thickness of the flue sheet of the boiler which is about to be treated, and not another. This is of vital importance or you may do more harm than good.

To use the spring expander, place it within the tube with the shoulder well up against the tube sheet. Now drive in the tapered pin, with a few light blows, and then jar it out in the usual way by striking it on the side. Repeat this operation several times, turning the expander a little each time until it has made a complete revolution. This type of expander (the spring expander) cannot be used while there is water in the boiler, as the jar of the hammer blows, as in the case of the beader, would loosen the other tubes. Use plenty of oil. This rule holds good with either type of expander, and do not forget to clean the end of the tube to be treated, taking care to remove all soot and scale before inserting the different tools.

Care must be taken in expanding tubes, not to expand them too hard, as in so doing the hole would be enlarged to such an extent as to strain the tube sheet and cause the adjoining flues to leak. When all of the leaky flues have been expanded they must be beaded down against the sheet, with an ordinary beading tool which closes up any remaining cracks, which may have formed during the expanding process.

G. J. PARRY.

IDENTIFICATION MARKS ON BOILERS.

I notice in the May issue the regulations governing the construction and first inspection of boilers agreed upon by the several provinces. I like this idea of stamping all boilers with the initials of the person issuing the certificate, and identification number, also the date of construction legibly and fully into a plate of the boiler. In this case all we would have to do, when taking charge of a plant, about which we knew nothing previously, would be to look for identification marks, then we could form some kind of an opinion of the age and tensile strength of such a boiler. I have been called to take charge of steam plants, and as I always make an effort to know all I can about the boiler in my charge, I ask my employer in the first place if he knows anything about the history of it, but all the satisfaction I get is usually this: "Oh! it's a very good boiler, I have had it 10 years (said one) and nothing has ever happened to it." Their theory being, of course, that as it hadn't "busted" during that period, that it is a good boiler.

But I always yearn for "washing out" day, so that I may inspect my new charge internally, and form my own opinions as to its capacity and strength. A lot of this anxiety will be done away with in the near future by the adoption of identification marks on the boiler itself, so that the dumb will be able to speak for itself to the engineer's relief.

All these improvements are to our own benefit as engineers, and I think that the government of Ontario will in the near future make the engineering profession something worth while, uplifting our standard.

G. J. PARRY.

SMOKE ELIMINATION.

One of the first friends I made on coming to Toronto a week or two ago, was The Power House, and I am very pleased to see that in your March number you have a good deal to say about smoke abatement.

Toronto is already a large, and a still growing city, and from all I hear is likely, in the near future to have a considerable increase in the number of factories in its immediate neighborhood.

You will readily understand that in the short time I have been here, I have not been able to fathom all the "whys and wherefores" connected with power production in this city; but two things have struck me forcibly in walking about the streets. There are: (1) Why are there any smoke producing plants at all with such an abundance of cheap electricity from the Falls across the way, and (2) If these "smokers" have a "raison d'etre" why are they not compelled to abate the awful nuisance they cause by their excessive black smoke?

You are probably aware that in the old country the local authorities are very strick in enforcing the smoke abatement clauses, and in London, and other towns, where large electricity stations exist, watchmen are kept on duty day and night to report by telephone to the stokeholes the color, and duration of the smoke issuing from the chimneys. They are provided with a smoke chart showing different densities which are allowed to exist for so many minutes only.

Rather an interesting case was brought up at the West Middlesex Police Court about two years ago in this connection. The Chelsea Borough Council sued the Underground Railways of London for excessive smoke production, and a great deal of conflicting evidence was given on both sides. Mr. Plowden, the magistrate who tried the case, visited the works himself, and was satisfied that everything had been done to reduce the smoke nuisance, and he dismissed the case with £400 costs against the B. C. This is the only instance I know where the man summoned has got off, and it used not to be a rare thing for one of the large London Cos. to get fined as much as 500 dollars a time, and fairly frequently too.

Now, I daresay it is more surprising to you in Canada where coal is dear, than to us in the old country where it can be got for a dollar a ton, that the internal combustion engine has not made greater headway. It is more economical, and does away with the smoke nuisance, as well as taking up less space than steam engines and boilers, etc.

Suction and other gas engines are, of course, pretty well known all over Canada; but very little reference is made to the Diesel oil engine, which is without doubt the best internal combustion engine on the market to-day. I enclose some remarks on this engine, which may interest your readers, if you have space to include them, and shall be glad to give them further information, or to show them drawings if they will write me.

By the way, the exhaust boiler for utilizing the waste gases from internal combustion engines ought to help the sale of the engines here, as the necessary heating of buildings can be done by means of such an apparatus.

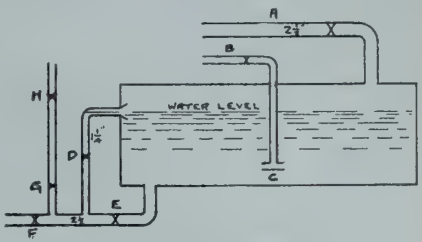
F. A. YERBURY.

A CLEVER IDEA.

Noticing in the April Power House an article entitled "A Clever Idea," I am sending the plan of a somewhat similar instalation that I put in myself and which to me appears better.

A is the boiler steam pipe. B a pipe down through the tubes to within 8 inches of the bottom, ending in a tee. C is for flushing both ends of the boiler. Normally, valves D and E are open, while F is closed. To blow off the boiler scum, close E and open F. For cleaning the boiler of deposits, close D and open F. H is a check valve in boiler feed pipe and G the controlling valve.

J. R. M.



A Clever Idea.

INTERPOLE MOTORS.

What are the advantages of interpole motors and generators?

L. ANDREWS.

Answer.—Articles have appeared in The Power House on interpole machines and one will appear in an early issue dealing with them. Briefly, the advantages are sparkless commutation at all loads, with fixed brushes, almost regardless of the strength of the main field. A smaller armature can be used in a dynamo for a given output and in a motor this permits a wide range of speed by field regulation.—Editor.

REPLIES TO IGNOTUS.

In the February number Ignotus asks for information as to size of wire, etc.

1. 2,500 16 c.p. lamps would require 1,250 amp. No. 4 wire would be required to conduct this two miles from power house.

2. No. 8 would be quite heavy enough in the town for primaries; No. 6 should be used for secondaries in main streets where heavy load is, and No. 8 in side streets.

3. No. 14 is big enough in small houses with 10 to 15 16 c.p. lamps.

4 As to meters, it has been my experience that in a small town it does not pay to put in meters, unless plant is overloaded. In that case it is cheaper to instal meters and charge rent for them than to buy new machinery.

As to day service, if enough customers were to be had to take power it might be made to pay.

Flat rates in the Crow's Nest Pass vary from .60 to .80 per 16 c.p. lamp. Meter rate about .15 k.w.

F. V. GALLWEY.

ANSWERS TO IGNOTUS.

(1) It is difficult to give a satisfactory answer to this question, as primary voltage is not given or % of power lost in line, but assuming a value for these and working out the problem, will give the readers the principle, and they can calculate the size of wire needed, where conditions are different, area of wire in

$$\text{circular mils} = \frac{DW_2t}{(PE_2)^2}.$$

Where—

D = length of line in feet (one way).
W_2 = total watts delivered at end of line.
P = % of power lost in line.
E_2 = voltage at receiving end of line.
t = constant having the following values.

2,400 for single phase system lights only.
3,000 for single phase system lights and motors.
3,380 for single phase system motors only.
1,200 for 3 phase, 3 wire, lights only.
1,500 for 3 phase 3 wire mixed load.
1,690 for 3 phase, 3 wire, motors only.

Then assuming voltage to 2,200 volts, and power lost in line 10%, and then substiting values for symbols in formula, we have the following circular mils

$$\text{required} = \frac{5280 \times 2500 \times 55 \times 1200}{10 \times 2200 \times 2200}$$

= 39,000 circular mils, allowing 55 watts per lamp.

A No. 6 wire has cross-sectional area of only 26,250 circular mils, and if it were used the loss would be much greater than 10%, and voltage regulation poor, although it has ample carrying capacity for this load and this voltage.

A No. 4 wire having cross-sectional area of 41,742 circular mils would be much better, and allow for some future increase in load.

(2) (a) The size of primary wires for branch lines would depend on load on each branch, and if, only a few lights were used a No. 8 wire would do, but a smaller wire than No. 8 is not advisable, as it is very liable to breakage in storms. (b) The secondary current output of a ten k.w. transformer is 91 amperes at 110 volts, and the carrying capacity of a No. 8 wire is only 46 amperes, therefore the No. 8 would do for the five k.w. transformers, but the larger ones would need two No. 8 wires in parallel or a No. 4 wire, unless the transformer was placed in the centre of the district to be lighted and half the load on each side of it, then the No. 8 wire would have proper capacity for each half of the load.

(3) The fifteen lamps would require about 8 amperes and No. 8 rubber covered wire has capacity of 12 amperes, so that it would have ample capacity, but the fire underwriters' code does not allow any smaller wire than No. 14 to be used in any case, except for fixtures and lamp-cord.

(4) The meter rate is used much more than the flat rate, as it is more satisfactory to all concerned, and average rate is about 9 to 12 cents per k.w. hours in towns of this size. Flat rates vary from 1 cent 2½ cents per 16 c.p. lamp per night, average being about 1½ for residence and 2 cents for business lights, with service till 12 o'clock midnight.

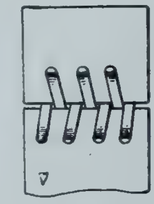


Fig. 1

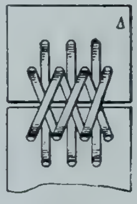


Fig. 2

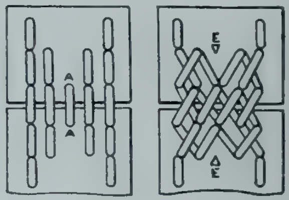


Fig. 3

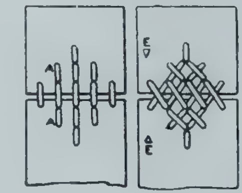


Fig. 4

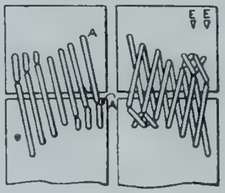


Fig. 5

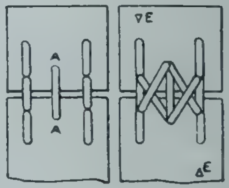


Fig. 6

The question as to whether a day service would pay can only be answered after a careful study of local conditions, such as amount of day load to be obtained, whether power is generated by steam or gas engine or water-wheel, extra labor, and extra plant or equipment required, etc.

Hoping that this may be of some use to Ignotus in solving his problems, and if he wishes a definite answer to all his questions, I hope he will send full details on all these points, and I would be pleased to answer either through The Power House, or by private letter.

A. J. DESAND.

BELTS AND PULLEYS.

The article on page 51 in April issue of The Power House has been especially noted, for very little information is obtainable on that subject. Much can be said to advantage, for a very common impression is that if a number of knots are put in the lace, that is all that is necessary. This article will give a few points I have gained from experience and careful reading.

The accompanying illustrations are some I found tacked up in a plant where the belts were in A1 condition. There illustrate the fact that efficiency and durability should be considered ahead of fancy or easy methods. Fig. 1, which explains itself, shows a joint often used over small pulleys at high speeds, and is called the hinge joint. Heavier work demands a joint of which Fig. 2 is an example. The outside holes are the first to be laced. For a general all round joint, Fig. 3 is satisfactory. The lacing is commenced at AA and finishes at EE. A favorite belt in Lower Canada is given by Fig. 4, and is very good. The lace commences at AA with ends at EE. Fig. 5 affords a good example for quarter twist work and is laced as usual from AA to EE. For small belts at average speeds, Fig. 6 is all that can be desired. In all cases, belts must be square ended with holes directly opposite, and the straight laced side to the pulley face.

Just a word on belt and pulley speed. Consider the case of a 4-foot pulley running 100 r.p.m., driving a 1-foot pulley. 400 r.p.m. would naturally be said to be the smaller pulley speed. This, however, does not take account of creeping or slipping of the belt, which changes these results. W. Bird states, that to be accurate both belt thickness and

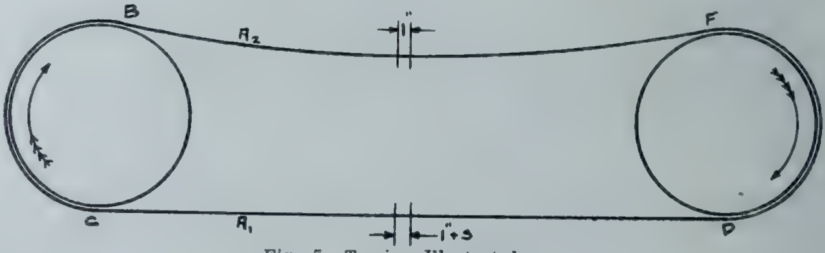


Fig. 7.—Tension Illustrated.

crown of pulley should be considered. The effective diameter would then be the average diameter of the pully (which is half the sum of the diameters at the crown and the edge), plus the belt thickness. Making these considerations, the smaller pulley speed would be only 390 r.p.m. Let us now consider slips. In Fig. 7, let H be the driven and E the driven; A_1 the tight side and A_2 the slack side, the direction of rotation being as shown. Observing a 1-inch length of the belt in the slack side it strikes pulley E at F, and begins to feel the increased tension as it nears D, and at that point has stretched to a length of (1+s) inches. This process is reversed on the pulley H, finally reaching B in its original 1-inch length. The difference in tension of A_1 and A_2 is the effective tension A. This varies with the load. When load is light, belt begins to stretch near D, while if heavy elongation commences nearer F, and if stretch tends to go beyond that point, the belt slips. It can be readily seen that pulley H must be running faster than E to take up this stretch.

JAMES E. NOBLE.

BOILER DESIGN.

Please allow me to call your attention to a slight mistake in the working out of one of the formulas in "Finding the value of (E) for the following joint (Page 31), March, 1910:—

Where

pitch =2".44.
d. of hole=.75".
d. of rivet=11-16"=(.6875).
thickness plate=5-16"=(.3125).
no rivets=2.

$$\text{Then } \frac{P-d}{p} = \frac{2.44-.75}{2.44}\times 100 = \frac{1.69}{2.44} = .69 = 69\%$$

the strength of the plate. And the strength of the rivets will be as "per formula."

$$\frac{N\times S\times A}{p\times t\times TS} = \frac{2\times 42{,}000\times .4418}{2.44\times .3125\times 60{,}000} = \frac{37111}{4575} = .81 = 81\%.$$

(Now you have it: 67% and 79%.)

On page 32, the formula given is not correct for finding the area of the segment above the tubes, owing I suppose to a misprint it is quite misleading. As it appears in your paper, it reads:—

$$\frac{4H^2}{3}\sqrt{\frac{2\times R}{H} - 658} = \text{area.}$$

It should be:—

$$\frac{4H^2}{3}\sqrt{\frac{D}{H} - .608} = \text{area of segment,}$$

the minus sign and decimal point are omitted.

You can see that they will both work out to widely different results.

J. A. McGILLIVRAY.

INJECTOR QUESTION.

How is this, that water naturally comes out at the overflow. But instantly changes its course, and instead of coming through this opening and nothing to obstruct it, only a loose cap hanging check valve against a similar pressure of 100 lbs? It is because the hanging check valve closes by a vacuum produced in the "delivery jet" chamber, in which is in connection with this said valve. It is why I have to give the water at correct proportion in order to create a vacuum in front of the valve.

C. N. ROACH.

In the "Injector Question" in the March issue of The Power House, I think G. J. Parry practically answers his own question. As he says the velocity of the efflux of steam is much greater than that of water, although the pressure is the same. In pressures usual in band boilers the velocity of the steam is from 16 to 18 times greater than that of the water. Suppose now that some of the steam were discharged at this high velocity through a pipe leading from a boiler, and while in the act of discharge it were condensed by passing through a cold medium, the resulting water would travel forward with the same velocity which it had when in the state of steam. Now if this water be gathered together into a continuous stream it would be more than able to force back into the boiler any opposing stream of water of the same size which might be directed against it from the water space of the boiler. The velocity of the condensed steam is so great that it possesses not only energy enough to re-enter the boiler in the face of an opposing stream of water of its own size, but it can also impart energy enough to a much larger mass of water so that the larger mass can also enter the boiler.

The supply of steam has got to be adjusted to suit the stream of water. For instance if the supply of steam be too small it will not impart sufficient energy to the water to carry it into the boiler, consequently it has to escape by the overflow. In such a case either more steam or less water will put matters right.

The injector may be described as an instrument for allowing steam to rush from a boiler, and to suck up and mix itself with a steam of cold water by which it is condensed, and to which it imparts so much of its own velocity that the combined mass enters into the boiler.

RICHARD BELL.

ELECTRICALLY OPERATED PUMPS.

Engineers in charge of electrically driven pumps in Canada are requested to send us information in regard to the amount of water carried, as well as data in regard to the machinery dimensions and the amount of current used. Address letters to The Power House, 10 Front St. E., Toronto, all acceptable information will be paid for.—The Editor.

IS THERE LOSS OF HEAT?

Is there any heat lost due to reducing the pressure in a steam pipe? For an illustration, if I have steam at 150 lbs., and put in a reducing valve in the line which gives me 60 lbs., do I have just the same heat as before?

WESTMOUNT READER.

The steam would be hotter at 60 lbs. in this case than if drawn direct from the boiler at 60 lbs. pressure.—Editor.

HEATING BUILDINGS.

I have considerable heating to do with both live and exhaust steam. I have found that by putting on a reducing valve at boiler and carrying same boiler pressure as when engines are running and carrying a pressure of say 5 or 6 lbs. pressure in the heating coils there is less condensation, for the return valves may be closed more closely than on exhaust pressure. The boilers fire about the same as when engines are running.

THOS. SCOTT.

A. J. Latronell, B.A. Sc., D.L.S., has been appointed City Engineer of Edmonton, Alta. Mr. Latronell has been acting City Engineer for two years. He graduated from Toronto University, Department of Engineering, 1903.

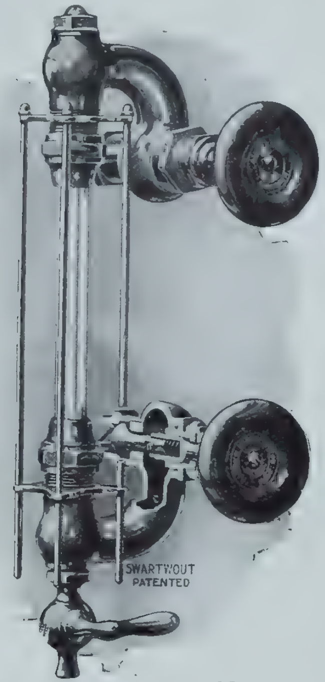
Norman D. Wilson, B.A. Sc., has commenced practice in Toronto as a surveyor and engineer. Mr. Wilson has had considerable experience in connection with railroad and municipal work. For the present he will have temporary offices at 41 Murray Street, Toronto, Ont.

J. G. Monahan, formerly with the Fire Underwriters' Electrical Dept., has accepted a position on the sales staff of Ferranti, Ltd., 1688 Dundas St., Toronto. Geo. C. Royce, the Canadian manager is now in England in connection with the extensive developments in connection with this company in Canada, announcements of which will be made on Mr. Royce's return. Dundas St., Toronto, has been re-numbered and the address of Ferranti, Ltd., Toronto, is now 1688 Dundas St., instead of 22 Dundas as formerly.

NEW EQUIPMENT *for* POWER PLANTS

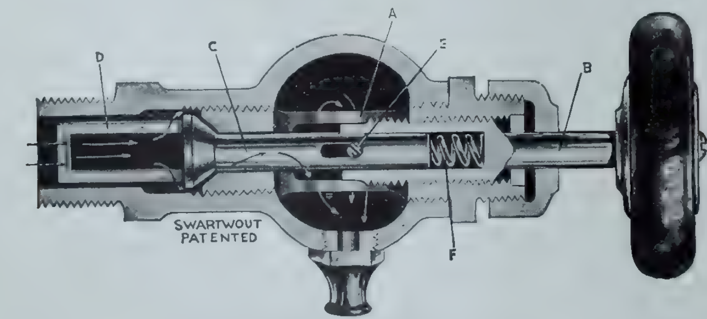
To Have a Place in this Department the Machine or Appliance Must
Have New and Interesting Features — No Write-Ups Can be Used.

SWARTWOUT WATER GAUGE AND GAUGE COCK.



Swartwout Gauge Glass.

The well known disadvantage of the usual form of gauge glass are lack of duability and the frequency with which it breaks, endangering the eyesight of the boiler attendant, allowing the water to escape from the boiler to a dangerously low level, and the difficulty and danger of replacing the glass, while the boiler is under pressure. To eliminate these difficulties, new and ingenious devices have been incorporated in the Swartwout Automatic Safety Water Gauge made by the Ohio Blower Co., and a similar design applied to the mechanism of the gauge cock.



Swartwout Automatic Valve.

The use of the gooseneck construction as shown by the accompanying illustration is one of the leading features, while the automatic valve with its removable valve case is the other. With the gooseneck construction the gauge glass is offset from the gauge bodies so that the glass may be cleaned, replaced, or blown out without in any way disturbing the gauge bodies or the valves. Because of the greater flexibility of the Swartwout, the strain common with other forms of gauge glass is practically eliminated, thus removing the greatest cause of gauge glass breakage. Goosenecks also permit a glass 2 to 4 inches longer than the other forms, an important feature when the glass is 25 or 30 feet above the ground.

The internal construction of the automatic valve and removable case is shown in both the accompanying illustrations. In the section of the gauge cock, the arrows show the path of the water and steam. The spring F holds the valve away from its seat while the device is in use, and to close a valve the handle must be turned until the spring motion is taken up. At the inner end of the valve there is a plate or flat prejection D, which acts as a scraper to loosen any sediment gathering in the boiler connection. With every turn of the hand wheel it revolves, thus maintaining a free opening. The valve is self-regrinding, every turn of the hand wheel moving the valve on its seat, so that whenever it is necessary to clean the valve parts or replace a broken glass, the turning of the hand wheel causes the regrinding action.

The illustration of the water gauge shows how independent of the gauge glass is the gauge body and the removable valve. The valve and seat is removed by taking out the valve casing A, which may be done without disturbing the gauge bodies or boiler connections. A small screw driver or pen knife will readily remove the screw E, which operation releases all the parts. In the ordinary forms of gauge glass the removal of the valve requires also the removal of the gauge bodies. A steam tight joint can be made by an extra turn of the gauge body, and repetitions of this operations make it extremely difficult to maintain a steam tight joint. With the Swartwout design the gauge body is never disturbed after it is once in position.

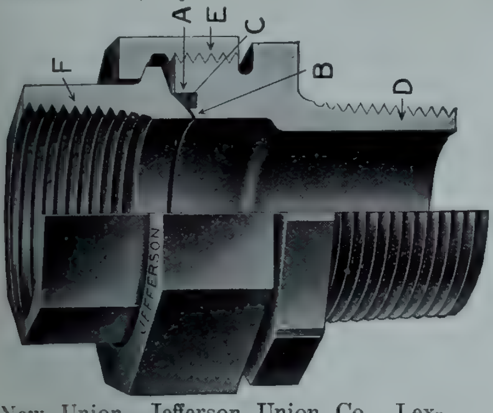
To operate a gauge glass and keep it in good condition is extremely easy. The glass is cleaned by removing the plug at the top or the drain cock at the bottom and inserting a swab; the glass need not be removed nor the packing disturbed. In blowing down the water column the valves never require resetting, and every time it is blown down the exact condition of the valves is apparent.

The Swartwout Automatic Safety Water Gauge is made to stand pressures up to 250 pounds per square inch, thus adapting them to all types of boilers and all kinds of service.

NEW JEFFERSON UNION.

Like other of the products of the Jefferson Union Company, Lexington, Mass., the new style F union, with one end externally threaded, has a spherical ground brass-to-iron joint. The brass ring A, which forms the seat or contact, is firmly embedded in a channel in the part having an external thread. All the rest of the fitting is of malleable iron. The ring is of wrought metal, cut from seamless brass tubing, avoiding the chance of blow holes likely to exist in cast brass. The brass-to-iron joint is used because it is noncorrosive With temperture changes brass expands or contracts more than iron, introducing a tendency for an opening to be left between the two metals. The smaller the amount of brass used the less serious is this effect, and in this union only enough is used to do the work.

The iron wall B absorbs the heat, distributing it through the iron, so that much less reaches the brass than in the usual constructions in which the brass is in direct contact with the fluid. This wall B, which is a patented feature, protects the brass from injury, no matter how far the pipe is screwed in. It makes the ring practically one piece with the iron, so that it cannot become dislodged. No gasket is used; this means a saving in time and expense. Plenty of play is allowed for the part F, which swivels in the nut, so that it is easy to make a tight connection even though the pipes are not in perfect alignment. The brass ring is cut at C to fit the spherical end of the opposing member, F. The two parts are then ground together.



New Union, Jefferson Union Co., Lexington.

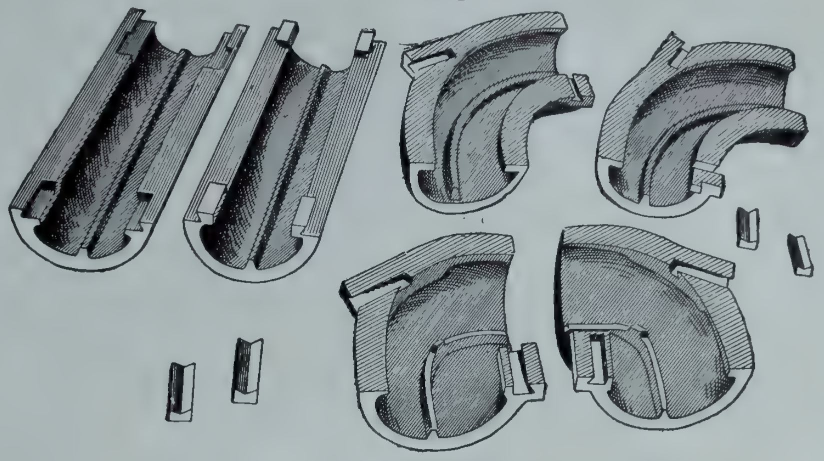
The union is especially short for its type, consequently it can be used for short connections where the ordinary union and nipple would be impossible. But short as it is, any style wrench with any width face may be used on any of the three parts. The octagon flats of all three parts are so arranged that there is no interference. On the clamping nut the flats are outside, clear of the corners of the part D having the external thread. On the part D the flats are outside and clear of the nut threads E.

BLOW-OFF PROTECTOR.

Mather's patent blow-off protector is a new device for protecting the blow-off pipes of steam boilers. It consists of a sleeve or covering of cast iron divided lengthwise, and has ribs projecting inwardly that make an air space of about half an inch between the pipe and sleeve. When the sleeve is run through the rear wall, or even part of the way, if a small space is left open around the blow-off pipe the draft inward will cause air to pass in and through this space to the elbow, and prevent the pipe from getting much hotter than the temperature of the water it contains.

The pipe will also be protected from deterioration and destruction by the character of the escaping products of combustion, and from expansion and contraction, caused by the changes of temperature of the escaping gases which envelop it when not properly protected.

The sleeve can be removed and replaced at pleasure for inspection of the pipe. It is fastened by a locking device inside, which is unlocked when either half of the sleeve is moved about an inch laterally. The elbow sleeve is constructed on the same principle, with ribs and an air space, and is fastened with keys in recesses. It can also be removed and replaced for inspection of joints at elbow.



Mather's Patent Blow-off Protector.

The Mather patent blow-off protector is made by the Paul B. Huyette Co., 1217 Betz Bldg., Philadelphia, Pa.

DIESEL OIL ENGINE.

The Diesel engine uses liquid fuel (crude oil, residues, etc.), and can be operated on any mineral oil without any alteration to the engine whatever, with satisfactory results. Crude petroleum is generally used for cheapness, and the utilization of the calorific value in the fuel reaches in the Diesel engine, a degree hitherto unattained by any other form of prime mover. The thermal efficiency, or in other words, the actual percentage of heat turned into useful work, in the most modern engines may be stated as follows:—

Steam engine, condensing ..	12 to 15%
Oil engine (explosive type)	20 %
Gas engine	30 %
Diesel engine	41 %

The engine is of the vertical type, working on the four-stroke cycle; but differs from all other internal combustion engines inasmuch as the temperature required for ignition is obtained solely by the compression of atmospheric air.

Having obtained in the cylinder a temperature above the ignition point of the fuel by compressing a charge of air in excess of the quantity required for perfect combustion, the fuel in the form of a fine spray, and thoroughly mixed with air, is gradually introduced at such a rate that the temperature and pressure during combustion, remain practically constant.

No combustible mixture exists in the cylinder during the compression and therefore pre-ignition is impossible.

Unlike all other internal combustion engines, the Diesel is not an explosion engine, and steadier running is assured by the combustion taking place gradually at predetermined, and much lower temperature, without material increase in pressure.

The cycle of operations is as follows: 1st stroke, air suction. 2nd stroke, compression and heating of air. 3rd stroke, fuel inlet, combustion and expansion. 4th stroke, exhaust of waste gases. This cycle is repeated every two revs. in each cylinder.

The fuel consumption varies from 0.4 lbs. in the large, to 0.5 lbs. in the smaller engines, and the fuel consumption varies very little over a wide range of load, as will be seen from the following figures from a 160 b.h.p. engine.

Load	Fuel consumpt. per bhp hour.
160 bhp.	0.40 lbs.
85 bhp	0.46 lbs.
60 bhp.	0.50 lbs.
40 bhp.	0.72 lbs.

The consumption of fuel is in direct proportion to the work taken from the engine, and the greater the load variation, the greater the superiority of the Diesel over any other engine on the market.

A tramway load is about the worst which an engine can be called upon to operate; but actual trials over long periods have proved the success of the Diesel under these conditions. The total works cost, including fuel, labor, maintenance, repairs and stores, at the Yardly power house of the Birmingham (Eng.) tramways works out at under 0.8 cents per k.w. hour delivered at the switchboard, and this figure is taken from the log book of the company.

The following advantages may be of interest to engineers in connection with the Diesel engine; but they do not cover the whole ground: small capital cost for a given plant, small space required, no stand-by losses, etc.

The Diesel engine can be started from cold, and in from one to two minutes be on full load, which is quicker than a steam engine even when under steam.

High flash point oil is used with which there is no danger from fire, etc., and there is no risk of men being poisoned by carbonic oxide gas. Engines are running 24 hours a day for 8 weeks on end, and are then only stopped long enough to change the valves as a precaution.

Varying loads can be met suddenly between one-eighth and full load, which cannot be done with producers and gas engines. Overloads of 25 per cent. momentary, and 10 per cent. for hours, can be carried; but engines should be installed for the maximum continuous load likely to come on.

Exhaust gases are colorless, and free from odor, and the exhaust can be made silent. Heating buildings. The exhaust can be used for heating, or even raising steam under pressure.

The Diesel engine is suitable for all purposes of power generation, and many engines are running on single phase, and three-phase generators, as well as driving continuous current dynamos. No trouble is experienced in paralling even with single cylinder engines.

These engines are running all over the world, and are working well at altitudes of as much as 6,000 feet above the sea (St. Mortiz, Switzerland), and there are now hundreds of thousands of h.p. in operation.

All parts are made to limit guage, and are absolutely interchangeable, so that for instance an exhaust valve could be taken from an engine running in Canada, and put into an engine of the same size in New Zealand with the certainty that it would fit properly.

All workmanship and material are of the highest grade, and all engines are run for one week continuously on full load before purchasers' tests are carried out at maker's works.

The Diesel Oil Engine is being placed on the Canadian market by the Canadian Boving Co., 164 Bay St., Toronto.

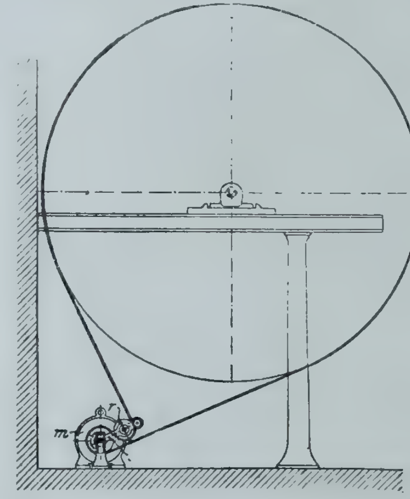
LENIX BELT DRIVE.

In laying out belt drives it is usual to conform, as far as possible, to certain theoretical rules. These, as set forth in text books and engineers' pocket books, have to do with the distance and relative position of the driving and driven shafts, and adherence to them is rather wasteful of space, as the shafts are not supposed to be vertically superposed and the minimum distance between pulleys is 15 ft. where narrow belts are used and twice that for wide ones.

To eliminate or, rather, reduce this waste, the F. L. Smidth Co., 50 Church Street, New York, has been using a device known as the Lenix. This consists of a belt tightening idler mounted between two arms which swing on an axis parallel and proximate to, or coincident with, that of the driving pulley, and are provided with weights at their free ends.

The illustration shows diagramatically a vertical drive where the ratio between the pulleys is 1 to 15. The Lenix is represented by r and the motor by m.

In operation the Lenix is placed on the upper side of the slack side of the belt and the counterweight is adjusted to give enough tension to cause the belt to grip the pulley face closely. This increases the arc of belt contact and reduces the slip to practically nothing. In this way it saves power, which is the first advantage claimed for the device.



Application of the Concentric Lenix Drive Where the Pulley Ratio is 1 to 15.

Another advantage claimed for the Lenix is that it reduces the amount of floor space required by enabling the prime mover and the driven machine to be placed closer together.

EXPORT OF ELECTRICITY AND NATURAL GAS.

The annual report of the gas and electricity inspection branch of the Inland Revenue Department shows that during the last fiscal year, ending March 31, 1909, the total amount of electricty exported by the four companies operating under the electricity and fluid exportation act was 359,283,286 kilowatt hours, as compared with 135,075,680 kilowatt hours generated for home consumption. The Canadian Niagara Power Co., exported 221,927,240 units, and generated for home consumption 5,405,760 units. The Electrical Development Co. exported 4,680,500 units, and generated for home consumption 85,515,700 units. The Ontario Power Co. exported 131,833,782 units, and the home consumption was 44,150,580 units. The Maine & New Brunswick Power Co. generated for export 841,764 units, and the home consumption was 3,940 units. Only one company was licensed to export natural gas during the year. The Provincial Natural Gas & Fuel Co., of Ontario, exported 387,019,000 cubic feet, and its home consumption was 462,707,000 cubic feet. After this no licenses will be issued allowing exportation of natural gas.

FIEL DCOILS.

The following method of impregnating field coils was recommended at the recent convention of the American Street and Interurban Engineering Association. The wire is insulated with asbestos, held in place by a cotton covering. The coil is wrapped with porus tape, and then placed in an air-tight chamber, and heated. The air in the kettle is exhausted, and when the proper vacuum has been obtained, melted asphaltum is permitted to flow in, after which air pressure is applied, forcing the material into the interstices of the coil. When the coil is nearly cool, it is brought to proper shape by means of clamping plates. When the clamps and tape are removed, the coil is covered with an insulation of varnished cambric.

WATER-POWERS.

At a meeting of the Executive Committee of the Commission of Conservation on February 2, 1910, the following resolutions were adopted:

(1) That a memorial be prepared and submitted, expressing the opposition of the Commission to the proposition to dam the St. Lawrence at the Long Sault, or to any similar proposition involving the construction of a dam across the St. Lawrence.

(2) That the meeting records its opposition to the export of power at Fort Frances being authorized by the Government.

The following is a resolution respecting waters and water-powers, adopted at the annual meeting, January 18-21, 1910:

That in future no unconditional titles to Water-powers should be given, but that every grant or lease of powers should be subject, among others, to the following conditions:

(1) Development within a specified time.

(2) Public control of rates.

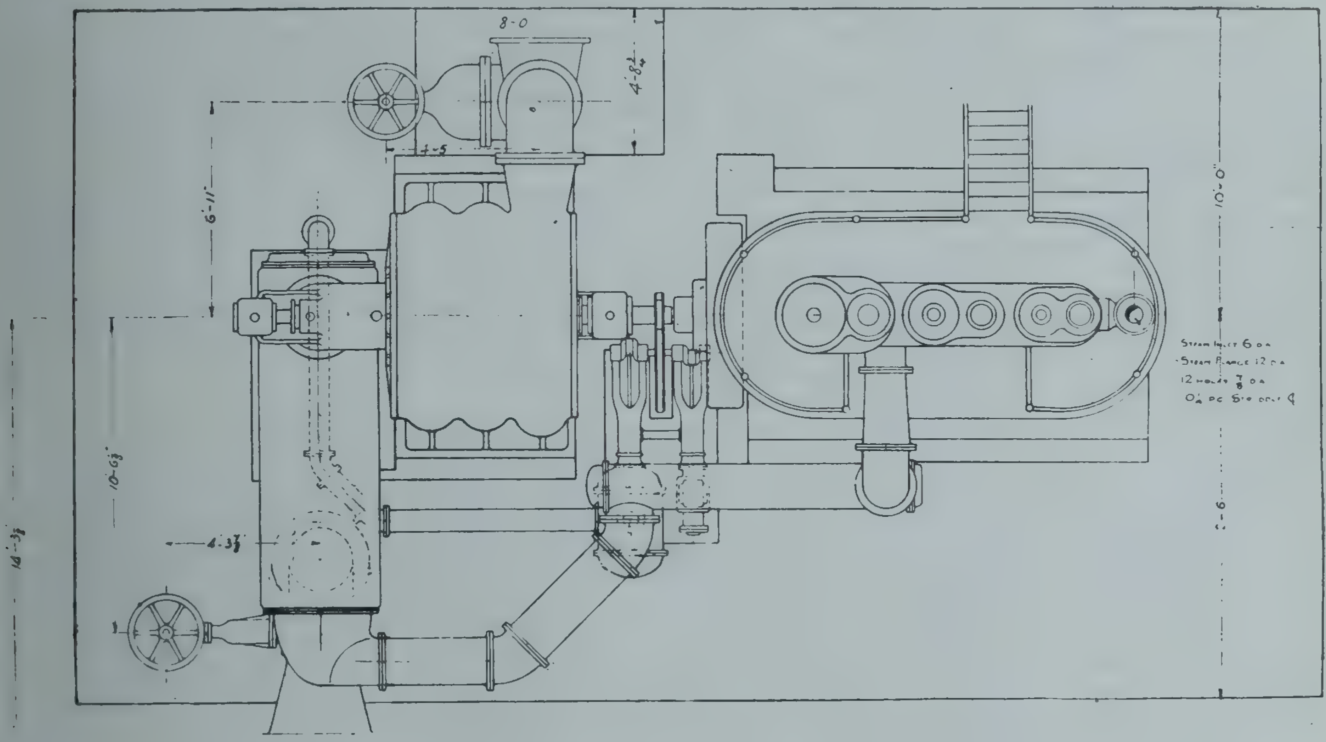
(3) A rental with the power to revise at a later period.

MONTREAL WATERWORKS PUMP TEST.

The performance of the engine driven turbine pump at the low level station of the Montreal waterworks is worthy of the attention of waterworks and hydraulic engineers because hitherto it was considered impossible to deliver water with commercial success against high heads by these means. The plant consists of a Worthington three-stage turbine pump, designed and built by the John McDougall Caledonian Iron Works Co., and a Bellis & Morcom 750 h.p. power triple expansion steam engine. The contract provided that the unit should have a duty of 100,000,000 foot pounds for each 1,000 lbs. of steam at 100 degrees superheat, allowance being made for all heat returned to the boilers.

An official test was conducted by R. J. Durley, professor of civil engineering at McGill University, who found that the duty of the pump and engine was equivalent to 110,151,000 feet lbs. per 1,000 lbs. of steam superheated 100 degrees. The indicated h.p. on the cards showed that the total overall efficiency was 70 per cent. This included not only pump losses and engine losses, but the power required to drive the air and feed pumps, which were attached to the main engine, and for which no allowance had been made. Although the duty obtained does not compare favorably with the best practice in high duty pumping engines, the contract price of the plant was only one-third of the price asked for vertical triple expansion pumping engines of equal capacity.

Considered as a commercial proposition, it will be found that the interest on this difference, added to the difference in the cost of engine house and foundations, will more than make up for the extra fuel consumption. The first test was conducted by Thomas Hall, M. E., on behalf of the city, and W. Clinton Brown, M.E., on behalf of the builders. It showed that the pump and engine reached a duty of 113,302,278 feet lbs. The superheat was 166 degrees, and the city authorities objected to the result on that ground, notwithstanding the fact that the boiler room was under their own control and that they were responsible for the high superheat.



Layout of Bellis & Morcom Engines, Turbine Pumps, etc., at Montreal Waterworks.

The second test gave a duty of 108,053,861 ft. lbs. at an average of 107 degrees superheat. Having the details of both tests before them, Hall and Brown calculated that, with the superheat at 10 degrees, this wood be equivalent to 107,588,268 ft. lbs.

The chairman of the Water Committee thought, however, that this duty was too high and insisted up a third test. This time R. J. Durley, professor of civil engineering at McGill University, had charge. He was assisted by Mr. Hall, but the builders were not represented. Professor Durley's test showed a total duty of 113,557,732 ft. lbs. at 119.6 degrees superheat, which he advised was equivalent to 110,151,000 ft. lbs. at 100 degrees superheat.

The reason for the variation in the results is that the city's tests took place in summer, when the feed water was warm and Professor Durley's test took place late in the fall, when the water was very cold, and the colder the water the greater the value of the return heat. If allowance is made for the variation in superheat and feed water, it will be found that the three tests check us so closely as to leave no probability of error, and that the high duty shown was really attained.

The contract provided that the pump and engine should have a duty of 100,000,000 ft. lbs. for each 1,000 lbs. of steam at 100 degrees superheat. It further provided for a forfeit of $2,000 for each 1,000,000 ft. lbs. below the stipulated duty or a bonus of $2,000 for each 1,000,000 ft. lbs. below the stipulated duty, but this bonus was limited to a duty of 105,000,000 ft. lbs. In consequence of the results shown by these different tests the city paid a bonus of $10,000 to the John McDougall Caledonian Iron Works Co.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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ENGINE STOPS A NECESSITY.

In a trial test recently of an 80 horse-power engine, being installed in the Guelph Stove Foundry, a safety pin fell out of the governor allowing the engine to run away. The man in charge of the instalation was at the door of the engine-room. Amid a dense cloud of steam, he pluckily rushed into the room and closed the throttle valve. Considerable damage was done to the engine. Six spokes of the ten-foot drive-wheel were snapped off, but fortunately the tire remained in place. The exhaust pipe was severed from the engine. The six stud bolts holding the body of the engine to the base were sheared and the stand was loosened on the bed. The threads of the anchor bolts were stripped, and the cement bed was split from end to end. The entire engine was moved **1½ inches along the bed.**

At the saw-mill in connection with the Doherty Piano and Organ Co., Clinton, recently the engine began racing and several men narrowly escaped being killed. Something went wrong with the governor belt and in an instant the huge fly-wheel raced until it finally collapsed and broke into a thousand pieces, some going through the roof and other parts of the building, landing several hundred feet away.

When one considers the number of rotating fly-wheels, it is remarkable that there has been such a small loss of life and property from fly-wheel accidents. That more accidents do not occur is probably due, in a great measure, to the watchfulness of the engineer in charge. The examples here given illustrate the force stored up in a fly-wheel. A safety speed stop and speed device will check racing immediately and prevent any possibility of accident.

There are a number of good devices on the market for the purpose of safeguarding engines from fly-wheel explosions. Explosions of fly-wheels running at the speeds for which they are designed, are very rare, but are mostly due to racing. The speed depends on the design of the fly-wheel. By the attachment of safety speed stop apparatus, a fly-wheel cannot travel at a faster speed than that for which it is designed, for the steam is immediately cut off in case any accident to the governor occurs.

Besides the number of devices on the market, home-made devices may be made, and though these may not be as neat in appearance as those manufactured for the purpose, they are very effective. Engines should be equipped with this attachment as a protection to the life of the workmen and for the safeguarding of property.

◆

PRACTICAL IDEAS.

Did it ever occur to our readers what a splendid opportunity for self-improvement they are allowing to slip through their fingers? The technical press is constantly requiring practical articles on practical subjects by practical men, and it is just you men, in charge of our various power plants, who are the very ones who can fill the above requirements to the best advantage, so get busy and show us what you can do. You all have ideas. You must have, for considerable knowledge is required to pass the examinations set by the different provincial authorities. This knowledge fits you to cope with the various exigencies that arise in your own particular field of activity, giving rise to such ideas as prove helpful to yourself and which ought to be disseminated among the rest of the engineering fraternity for their benefit, should similar occasions arise in their practice.

Let each one attempt to express these ideas on paper, and it will be surprising how much benefit you will derive by so doing. Possibly your first attempts will be crude—and for that very reason you should attempt something, as practice will improve, and we in the office will help to brush them up, to our mutual benefit. Don't continue to "hide your talent under a bushel," but come out and give us your ideas. Put them in form if possible, but at any rate, send in the idea, and it will be worked up for you. Read this editorial over again and give it your serious thought.

◆

By equipping a pair of engines with a continuous oiling device, oil shields, tank and filter one manager saved the difference between $25,00 and $75 00 each month on his oil bill.

Purposes of the Secret Commissions Act Explained

The Act was Explained to the Wholesale Grocers at a Recent Convention —It Applies to all Manufacturers and Dealers and to Purchasers.

By E. F. B. Johnston, K.C.

I wish to direct your attention to an Act that was passed a short time ago. There was a great deal of trouble in regard to many commercial matters as between agents and contracting parties, and Parliament passed an Act dealing with that very subject, and that is known as the Secret Commissions Act of 1909.

Under that Act an agent means any person employed by another. In the desire for business, and in the effort to make big returns, and sometimes perhaps if the agent is paid by commission, in his self-interest he will go to a prospective buyer and will say, "Here are so many packages; they will cost you $12." The retail buyer says, "No, I won't buy them. I believe I can get them cheaper from another man." The agent says, "I will allow you a rebate," and he does it in this way. He says, "I will give you a dollar," or fifty cents, as the case may be, which would be a very high percentage upon a twelve-dollar lot of any particular article. He gives him the fifty cents, or the dollar, the man buys the goods, and gets his rebate in that surreptitious way.

The agent, if his principal is honest, dare not return it to the principal, because he knows his principal is under a moral, if not a legal, obligation, not to sell at less than a fixed price. He returns it as his expenses, sends in the voucher and adds the fifty cents to the week's account. He has got the order, and thinks he has done an honest transaction.

A great deal of wrong-doing may take place in that way, but when we come to the Act, whatever view may be taken of the earlier sections—I have some doubt myself as to how far they apply—but when we come to Section (c) of the Act you will find this, "Being an agent," that is, a person employed by another—"being an agent, knowingly uses, with intent to deceive his principal, any receipt, account or other document in respect of which the principal is interested and which contains any statement that is false or erroneous or defective in any material part, and which to his knowledge is intended to mislead the principal."

What the Penalties Are.

The man who does that is liable on conviction to two years' imprisonment, or to a fine not exceeding $2,500, or to both. The agent violates his principal's contract by selling below the fixed price; he is cutting the price. He is not doing it in the interest of his principal, because his principal loses the fifty cents or the dollar, as the case may be—I am only taking this small amount to illustrate. He is using his principal's money for a certain purpose that is not proper, and in addition to that he is returning his voucher to his employer, which is false and intended to mislead his employer, because he wants the employer to believe that the fifty cents was traveling expenses, or traveling allowance, instead of the rebate, which was an unlawful act.

It is well for the public to know this. But apart from that let us see what the statute says. We have a particular statute known as the Criminal Code, and I have summarized a section in order that it may read to you intelligently. Statutes are often passed which are not intended to read intelligently, because if they did and any man could understand them, my occupation would be gone.

This is Section 415 of the Criminal Code, which I have summarized, "Any person being a clerk or servant who falsifies any book, paper or writing, or makes any false entry in any book, paper or writing, belonging to his employer, or that has been received by him on behalf of his employer, or concurs in the same being done, is guilty of an indictable offence," and liable to maintenance, food and clothing at the expense of the state for seven years.

I say that the agent who goes out, without the knowledge of his principal, and does these things for the purpose of cutting prices, will find himsell in grave difficulty some day, if not under the Secret Commissions Act, at any rate under Section 415 of the Criminal Code.

Now just a moment with regard to the Secret Commissions Act, and see what was intended to be covered by it. The Secret Commissions Act was intended primarily, no doubt, to prevent violation by agent under contracts of various kinds. The consideration, of course, to the agent that is mentioned in the Act would be the man buying the goods. It is to the personal advantage of the agent that he sell the goods, it is to the personal advantage of the agent that he extend the business of his employer, because so will he be rewarded, not only here, but hereafter. Under that condition of things, to begin with, the account he returns to his employer, is absolutely false; and let me say, if the manufacturer stands in with his agent in the deal and knows it, and authorizes it, either expressly or impliedly, the agent is not responsible. But I am taking a case where the agent does it on his own account, and for the purposes which I have mentioned.

To Bring About Honest Dealing.

The object of this Act was manifestly this: to keep the agents and all persons dealing with them, honest. That is the first proposition. The principal, the manufacturer or dealer, is not there; he has to trust his agent, he cannot go round and control every act of his traveler, he cannot see that the law is carried out or if his contracts are carried out; he must trust his agent, and it was important that some safeguard should be given to the employer in regard to the conduct of his agent, so that if he did that which was illegal he might be reached in some summary way.

The second object of the Act was to prevent the rules and contracts and regulations of the employer from being broken. Otherwise there would be no check. An agent could go about and break all the rules and regulations you could put in force. Then the third object was apparently to prevent collusion between the agent and the person he was dealing with, which was one of the most important elements of the Act.

Now you see how readily it could be done in the way I have indicated, and I am told that is the way it is done. I am advised that is the fact, and I am pointing out that that being the fact, such a man is liable under the section; and if he is not liable under that, he is clearly liable under the section of the Code.

News of Societies

Officers of Engineering Societies
and Current News of Associations

Officers of Engineering Societies

Canadian Society of Stationary Engineers.

President, Charles Kelley, Chatham, secretary, W. A. Crockett, Mount Hamilton P.O., Ont.

Toronto No. 1 C.A.S.E.

Meetings 1st and 3rd Fridays each month at Forum Hall, corner Gerrard and Yonge Streets. President, W. C. Tait; secretary, A. Kirby.

Ottawa No. 7. C.A.S.E.

Meetings 1st and 3rd Thursday, 325 Dalhousie St., F. J. Merrill, Secy.

C.A.S.E. Exhibitors' Association.

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North West A.S E.

President, R. Nivens, secretary, E. H. Oliver.

Canadian Society of Civil Engineers.

Rooms at 413 Dorchester Street West, Montreal. President, Col. H. N. Ruttan; secretary, Prof. C. H. McLeod. Meetings will be held at Society Rooms each Thursday.

Quebec Branch of C.S. of C.E.

Chairman, L. A. Vallee; secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

Ottawa Branch of C.S. of C.E.

Chairman, W. J. Stewart, Ottawa; S. J. Chapleau, Box 203.

Toronto Branch of C.S. of C.E.

96 King Street West, Toronto. President, J. J. G. Kerry; secretary, E. A. James, 62 Church Street.

Manitoba Branch of C.S of C.E.

Chairman, J. E. Schwitzer; Secretary, E. Brydone-Jack. Meets first and third Friday of each month, October to April, in University of Manitoba.

Vancouver Branch of C.S. of C.E.

Chairman, Geo. H. Webster; secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

Nova Scotia Society of Engineers, Halifax.

President S. Fenn; secretary, J. Lorne Allan, 15 Victoria Rd., Halifax, N.S.

Canadian Electrical Association.

President, N. W. Ryerson, Niagara Falls; secretary, T. S. Young, Canadian Electrical News, Toronto.

Universal Craftsmen Council of Engineers. Canada Council.

Chief, Thos. Cole; secretary, Albert Slaute. Meets second Tuesday in each month in Room 2, 4th Floor, Temple Building.

Toronto Branch A I.E.E.

Secretary, W. H. Eisenbeis, 1207 Traders Bank Building.

Engineers' Club of Toronto.

96 King Street West. President, C. M. Caniff, secretary, R. B. Wolsey, 25 Lowther Ave. Meetings every Thursday evening during the fall and winter months.

Edmonton Engineering Society.

President, Dr. Martin Murphy; secretary, B. F. Mitchell, City Engineer's office, Edmonton, Alta.

Canadian Railway Club, Montreal.

President, A. A. Maver; Secretary, James Powell, Box 7, St. Lambert, near Montreal. Meetings at Windsor Hotel, 1st Tuesday of each month, except June, July and August.

Central Railway and Engineering Club, Toronto

President, J. Duguid; Secretary-Treasurer, C. L. Worth, Room 409, Union Station. Meetings at Prince George, 3rd Tuesday of each month, except June, July and August.

Western Canada Railway Club.

President, Grant Hall; secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Meetings second Monday, except June, July and August, at Winnipeg.

Ontario Municipal Association.

President, Mr. George Geddes, Mayor, St. Thomas, Ont.; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

Union of Alberta Municipalities

President, H. H. Gaetz, Red Deer, Alta.; Secretary-Treasurer, John T. Hall, Medicine Hat, Alta.

Union of Nova Scotia Municipalities

President, Mr. A. E. McMahon, Warden, King's Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

Union of Saskatchewan Municipalities

President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

Union of Manitoba Municipalities

President, Mr. Menlove, Virden; Sec.-Treas., Councillor Cardale, Blanchard, Man.

Union of British Columbia Municipalities

President, Mayor Bell, Enderby; Sec.-Treas., Mr. Planta, Nanaimo.

SOCIETY NEWS.

As announced in a previous issue of The Power House, the Canadian Electrical Association will hold their annual convention at the Royal Muskoka Hotel, Muskoka Lakes, on July 6, 7 and 8. A very interesting programme has been arranged, and some of the leaders in the electrical industry and the most prominent electrical engineers in the United States and Canada will be present.

* * *

A Canadian branch of the International Electro-Technical Commission has been formed, Prof. L. A. Herdt, head of the Electrical Engineering Department, McGill University, Montreal, being elected chairman. The other members are Dr. H. T. Barnes, McGill University; Prof. T. T. Rosebrugh, Toronto University; Prof. L. W. Gill, Queen's University, Kingston; Mr. O. Higman, chief electrical engineer, Electrical Standards Laboratory, Ottawa; John Murphy,, electrical engineer, Railway Commission, Ottawa; W. A. Duff and A. B. Lambe, Winnipeg. This commission which has local committees in practically all countries, has for its purpose the standardization of nomenclature and ratings of electrical apparatus and machinery. Meetings of delegates of the various national committees meet once a year in London, England. The present committee, named by the Canadian Society of Civil Engineers, is the first move that has been made in Canada in this direction, although in 1906, at the inaugural meeting in London, Prof. Herdt was the Canadian representative and last year Mr. O. Higman attended the annual meeting.

* * *

A fund has been established at McGill University, Montreal, by the Applied Science class of 1899, to be known as the "Class of 1899 Fund, for the purpose of aiding, each year, one or more students who upon the completion of their second year work require assistance to enable them to finish their course of study. The loans from this fund made to students will be repayable after graduation. Applications are to be made through the Dean of the faculty of Applied Science.

* * *

The annual convention of the C.A.S.E. at Berlin, July 26-29, promises to be a record-breaker. The papers by prominent authorities will add to the interest of the convention. J. B. Goff, of the Dart Union Co., Toronto, is secretary of the Exhibition Association, and is receiving more applications for space than expected. The prospects are that the convention and exhibition of power specialties will surpass any previous convention.

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At the December, 1909, meeting of the Northwest Association of Stationary Engineers, C. C. Snowden, Calgary, offered three prizes to the engineers holding first, second and third class certificates, who sent in the best essays on "what are the greatest troubles with which engineers have to contend." The essays were sent to the editor of The Power House, who decided that E. H. Oliver, Calgary, won the prize in the first-class, and Pat Lavele, Exshaw, the second class. No engineer holding third class certificates entered the contest. The third prize was therefore awarded to R. McDonald, Edmonton, holder of a second class certificate. It is the intention of the association to hold another contest, and it is hoped that every western engineer will take a personal interest in it.

* * *

The next annual convention of the American Order of Steam Engineers will be held at Odd Fellows Temple, Philadelphia, Penn., June 6 to 10. Fred L. Jahn, of the Watson & McDaniel Co., Philadelphia, is the secretary of the American Supply Men's Association, which has the exhibition in charge. F. C. D. Wilkes and R. B. Heustis, of The Power House staff will attend this convention and Canadian readers will be kept posted in regard to the latest steam engineering as shown in the papers read at the convention, and new equipment shown at the exhibition of steam specialties.

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At the recent meeting of the International Association of Municipal Electricians, a resolution was adopted favoring the grounding of secondaries in alternating-current systems. The resolution calls attention to the fact that life and property have been destroyed from high voltages on alternating-current secondary systems, because of the failure of insulation between primary and secondary circuits, and that such dangers may be obviated by grounding the secondary, and it demands the enactment of legislation requiring all alternating-current secondary systems to be grounded, when by so doing the voltage between the earth and any part of the secondary systems will not exceed 250 volts.

* * *

The twentieth annual At-Home of Hamilton No. 2 Lodge, C.A.S.E., was held in Kennedy's Hall, Hamilton, on March 24. There was a large attendance of engineers and their lady friends to enjoy the programme, supper and dancing. Arrangements were in charge of A. Cousins, president, and C. A. Leckie, secretary.

NIAGARA POWER PLANTS.

"Niagara Power Plants" was the subject of a lecture delivered by Professor Robert W. Angus, of Toronto University, at London recently, under the auspices of the London, No. 30, Canadian Association of Stationary Engineers.

In introducing his lecture, the speaker stated that it was only in very recent years that Canada had begun to develop its water power. There were several causes for this. First, there had been such an abundance of cheap fuel in the past that it was unnecessary, and it was not until the fuel supply began to be in a measure exhausted that the water power was considered seriously. Then in the past industries in Canada had not been very highly developed, and power was not as much needed, and another reason was that until a few years ago it was impossible to transmit water power to any distance. For this reason power-development schemes were not started till 1905-6.

Niagara is not the only source of power. There are several plants on the Georgian Bay developing 10,000 horse power, and on the Trent River and elsewhere, but Niagara Falls is by far the most important.

The falls and rapids together represent a fall of 325 feet from the level of Lake Erie to that of Lake Ontario, practically all of which can be used. There is a drop of 55 feet from the Dufferin Islands to the brink of the falls, enough in itself to generate an immense amount of power. The falls itself represents a drop of 158 feet, while in the water below there is a drop of almost 100 feet, which gives another source of power.

"It is not likely," said the speaker, "that we will ever be able to utilize all the power, because that would destroy the falls, and it is looked upon as a national asset, because of its beauty, and its power to attract tourists and desirable settlers to the country.

"If we were to develop all the power we would have 3,500,000 electric horsepower. The immense strength this represents can be understood when it is known that Toronto for all purposes uses only 40,000 horsepower.

"Of the available water 93 per cent. passes over the Horseshoe Falls, only 13 per cent. of this being owned by the United States, so that Canada owns four-fifths of all the power."

There are at present three power companies in Canada: The Canadian Niagara Power Co., which was opened in 1905, with a charter to develop 100,000 horsepower, sells very little power; the Ontario Power Co., from which the Ontario Government will draw the power for its power schemes, was chartered to develop 180,000 horsepower; the Electrical Development Co. was chartered to develop 125,000 horsepower.

These three companies are at present developing 300,000 horsepower, or using about one-tenth of the available supply of water going over the falls. It is expected that they will ultimately develop some 700,000 horsepower, or about one-quarter of the available amount of water.

The speaker went on to discuss in detail the plants of these three companies and the immense difficulty and cost of this harnessing of Niagara. The lecture was illustrated with a large number of very fine views, illustrating the plants in course of construction.

PERSONAL NOTES.

W. J. Paynter, St. Mary's, has been appointed chief engineer of London St. Ry. motive power.

Chas. L. Gulley, B.A.Sc., who has been demonstrator in electricity, University of Toronto, has taken a position as power sales engineer with the Toronto Electric Light Co.

S. J. Hungerford, shop superintendent for the C.P.R., at Winnipeg, has been appointed superintendent of rolling stock for the C.N.R. with headquarters in Winnipeg.

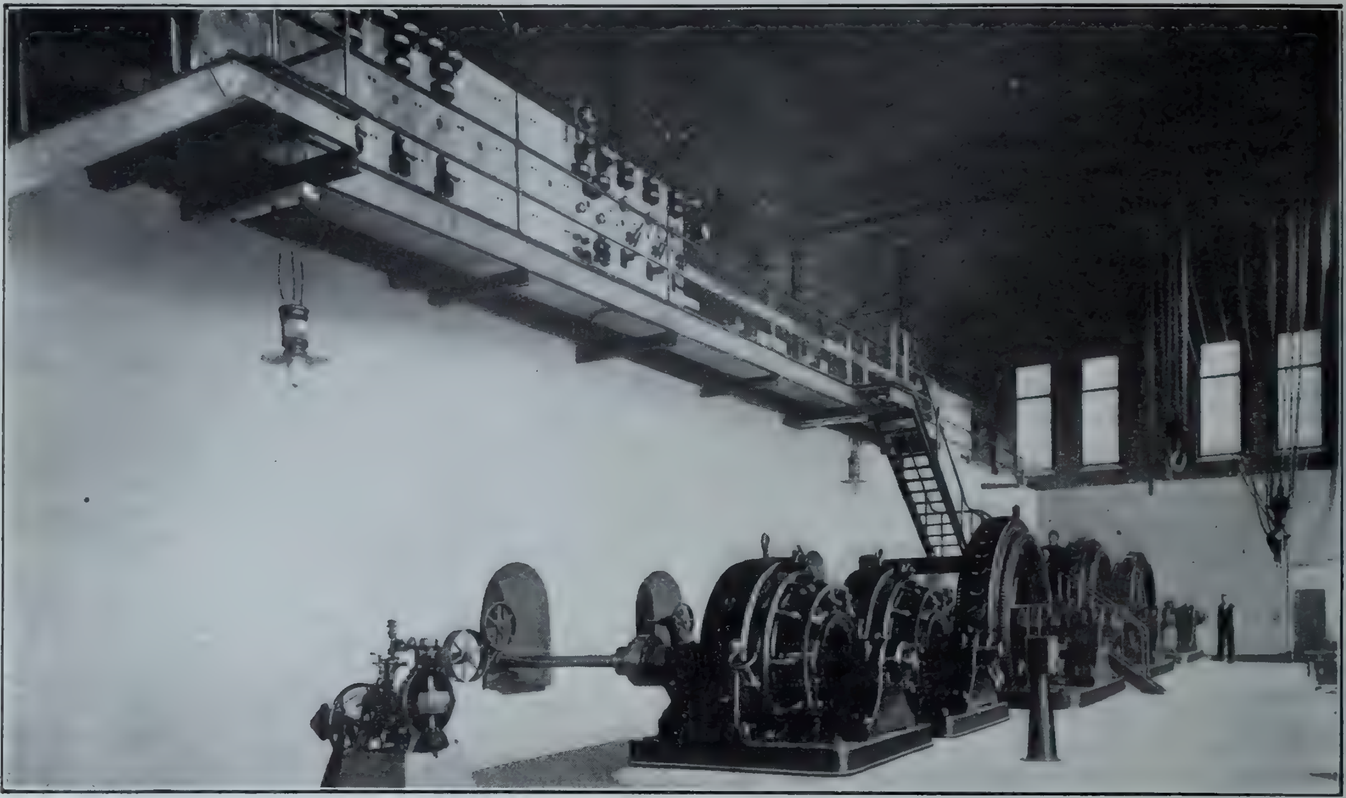
Thos. Hewitt, for nearly 40 years connected with the Kingston waterworks, most of that time as superintendent, has resigned, intending to take a year's rest. He will probably take up consultation work.

J. J. Campbell, formerly connected with the Canadian Westinghouse Co., Montreal, has accepted a position with the General Electric Co., of Sweden. The Canadian company is Kilmer, Pullen & Burnham, H. D. Boyne being manager of the Montreal office.

Messrs. Jago & Harris (F. J. Jago and R. R. Carr Harris, C.E.), civil engineers and reinforced concrete contractors, have opened an office at Toronto in the Confederation Life Building. Mr. Jago will remain in charge of the Montreal office, 518 Coristine Building, while Mr. Harris will conduct affairs at the Toronto end.

Nicholas R. Mudge died March 28th at his late residence, 29 Lorne Avenue, Montreal. He had been widely known in industrial and commercial circles because of his connection with boiler inspection and insurance interests. He had retired from active business and for a period of six years was an invalid, being confined to his residence during that time. The late Mr. Mudge was a resident of Montreal for forty years, coming here from Torquay, Devonshire.

S. Gagne, B.A.Sc., of O'Brien, Gagne & Jennings, was killed at Chicoutimi, Que., on April 14th, by a landslide, caused by an explosion of blasting powder in one of the cuts on the line of the Ha Ha Bay Railway, which this company are building. Mr. Gagne graduated from the Faculty of Applied Science of Toronto University in 1901 with the degree of B. A. Sc.. For many years Mr. Gagne was associated with the late W. T. Jennings, and more recently in partnership in engineering work in Toronto with Gordon Jennings. About a year ago Mr. O'Brien joined Mr. Gagne and Mr. Jennings, and they undertook the engineering and the construction of a section of the Ha Ha Bay Railway.



Interior of Kenora's 5,000 Horse Power Hydro-Electric Plant.

KENORA'S INTERESTING POWER PLANT.

Kenora is situated on the Lake of the Woods where the lake is drained by the Winnipeg river, there being two outlets, the eastern and western. Across the western outlet is a regulating dam which maintains the lake at a uniform level. Across the eastern outlet has been erected a brick power house in which is installed machinery to develop 5,000 h.p. Through the western wall is provided a log sluice. The breast wall tail race arches and flume walls are of concrete and the power house is of brick with steel frame work and wooden roof. The head gates are of wood, raising in two sections, one in front of the other, with two sets of gates to each flume or wheel chamber. Seven flumes 18 feet wide, with 4-foot dividing walls of concrete ; the central flume is divided into two equal compartments by a 2-foot reinforced concrete wall, and contains the two exciter wheels, thus providing for six power units and two exciter units. Each flume is provided with a 12-inch cast iron pipe and valve for filling the flume, in order to equalize the water pressure on both sides of the head gates before opening them, and an 8-inch valve for emptying the flume in case of inspection of wheels, or for repairs.

Each hydraulic unit consists of two pairs of 40-inch Samson turbines, made by the William Hamilton Mfg. Co., Peterborough, mounted on a horizontal shaft, which is direct connected to the generators through flange couplings. Each unit will develop 900 H.P. at the generator coupling when operating under a 17-foot head at 150 r.p.m. The wheel gates are of the register type, and are controlled by a sleeve ring connected by links to, and actuated by, a single shaft connected to the governor, and carried in bearings on top of the wheel setting or draft chests. The water wheel main shaft and the gate shaft are carried through a heavy cast iron bulkhead, which is provided with stuffing boxes for that purpose, and is set in the concrete wall, which is 6 feet thick, and which divides the flumes from the power house. A heavy collar bearing is set and anchored in this wall, immediately in front of the cast iron bulkhead, and this takes care of any end thrust in the turbine shaft. The exciter units, which are two in number, are situated in the centre of the building, each ,constitutes a single pair of 30-inch Samson horizontal turbines direct connected to d.c. generators. The large units are each controlled by Lombard water wheel governor, and each exciter unit is regulated by a Woodward governor of the compensating type.

The electrical equipment consists of three a.c. 3-phase, 60-cycle, 2400-volt Allis-Chalmers-Bullock generators of the revolving field type, of 625 k.w. capacity each running at 150 r.p.m. ; and two exciters of 175 k.w. capacity each, running at 175 r.p.m. The generators are designed to operate continuously at a load of 500 actual kilowatts at a power factor of 80 per cent. and at a potential of 2400 volts.

The cables from the electrical machines are carried through ducts in the floor to the switchboard, and out through the east gable of the building, where they connect to the transmission line leading to the town, which is approximately one mile from the power station.

The switchboard, which is of blue Vermont marble, consists of 12 panels divided as follows : 5 feeders, one exciter panel, three generator panels for present equipment, and three panels for future generator installation. The switches, bus bars, feeder mains, etc., are carried on an insulated structure nine feet to the rear of the operating board. Each generator panel is equipped with ammeter, volt meter and synchronizing receptacles. These are so connected to the synchroscope swinging on an end bracket on the switchboard that by means of the cross connecting plugs furnished with the board the synchroscope can be made to indicate for any one of the three generators, thus permitting the generators to be thrown together in any order desired. The feeder panels are equipped with three ammeters, as well as the 6-pole, high voltage oil switch, which in time of emergency permits the instant breaking of current in the feeder circuit. The exciter machines are furnished with equalizing pedestay and switch, enabling the excitation of the generators to be thrown from one exciter to the other without even a momentary pause in the operation of the plant.

The complete power plant has a capacity of 5,000 h.p. The equipment includes a 20 ton hand power crane. The general designs, plans and specifications for the work were prepared by T. Pringle & Son, hydraulic and mill engineers, Montreal, and the construction was carried out under the supervision of G. M. Wynn, who was their resident engineer at Kenora.

Interesting Water System Instalation at Ottawa

Pneumatic Plant with 36 ft. Tank to be Buried in the Ground, Gasolene Engine Auxiliary, Plant Works Automatically.

The fire that utterly destroyed the handsome buildings of the Ottawa Golf Club last fall provides a striking example of the inefficiency, and in most cases, absolute uselessness in an emergency of the old-fashioned elevated tank system of water supply.

In this instance the fire was discovered in its early stages, and, had an efficient water service been available, there is no doubt whatever that the buildings could have been saved, but while a considerable quantity of water was in the tank the pressure was so low that nothing could be done and the buildings were entirely destroyed.

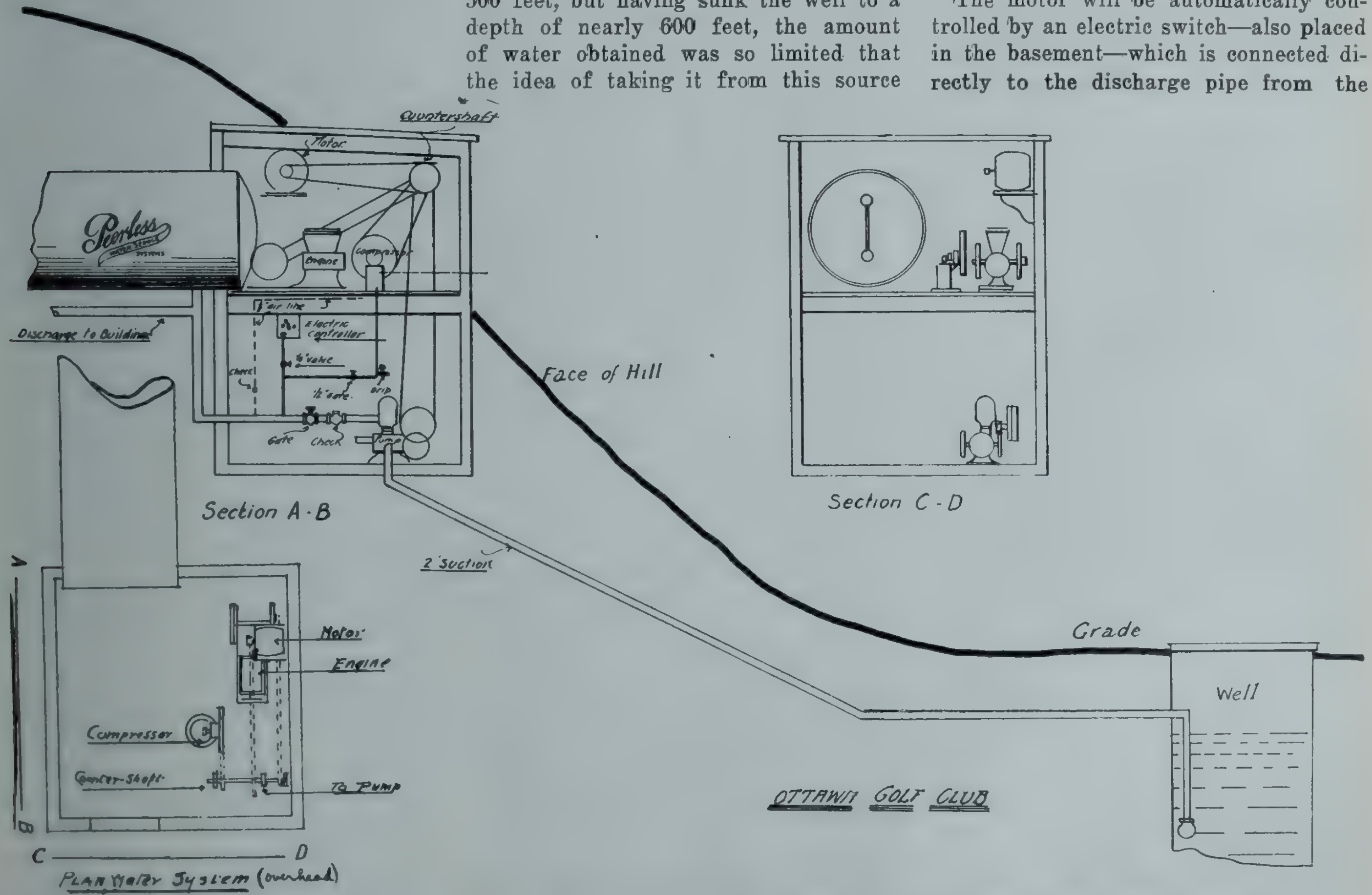
At the present time contractors in every trade are rapidly rushing to completion what will be one of the most handsome and complete golf club buildings on the continent, but having learned a very expensive lesson, the members have insisted on one radical departure from the old plan, viz., the instalation of a pneumatic water service plant, which will provide water, not only in large quantities, but at a pressure equal, if necessary, to that found in any Canadian city, and have awarded the National Equipment Company, Toronto, the contract for the whole system, which will be installed under the direction of this company by a local plumbing concern, the tenders now being called for.

Some difficulty was experienced in obtaining a sufficient supply from an artesian well. It was expected by the club officers that water would be struck at 300 feet, but having sunk the well to a depth of nearly 600 feet, the amount of water obtained was so limited that the idea of taking it from this source was temporarily abandoned, and it is now being taken from a shallower well situated on the property about 40 or 50 feet below the point on which the club-house stands.

Figure 1 is a sketch through A—B of the plan figure 3 and shows in detail the whole equipment that is being installed. The tank, which is 36 feet long, which incidentally is the longest pneumatic tank in Canada, is buried underground with the head projecting into the pump-house, which is of cement, and partially buried in the hill; the pump being placed in the basement of the pump-house, which, as will be observed, is entirely surrounded by earth and consequently will be frostproof.

The motive power consists primarily of a two horse-power electric motor, connected to a countershaft, from which a belt is carried down through the floor to the pump in the basement. The pump is connected by 2-inch suction pipe, running direct to the well and fitted at the bottom with a foot-valve. The discharge pipe from the pump is taken straight through the wall of the building, and up through the soil into the bottom of the tank, and at a point just below the tank a 2-inch discharge is taken straight to the club house building. It will be seen, therefore, that no portion of the piping system is exposed to the frost.

The motor will be automatically controlled by an electric switch—also placed in the basement—which is connected directly to the discharge pipe from the



Sectional View from Well to Tank on Hillside, Overhead Plan of Water System and Front View of Engine House.

pump by a ¼-inch pipe fitted with a globe valve. This switch contains a diaphragm similar to that used on a steam boiler damper regulator, and when forced up by the pressure in the discharge pipe throws the switch out, allowing the motor to stop.

When the pressure goes down to 20 or 30 pounds, according to the desire of the operator, the diaphragm recedes and the switch is thrown in, starting the motor and pump, which will continue in operation until the pressure is sufficient to force the diapragm up and throw the switch out again.

Providing against all contingencies, a two and one-half horse-power gasolene engine is installed and kept ready for immediate use should anything happen to the electric power at any time, and connected to this engine is also an automatic switch, which will stop it as soon as a pre-determined pressure has been reached in the tank.

A water-jacketed air compressor, which may or may not be required, is installed and belted direct to the countershaft. This air compressor, which, however, is only used in connection with large systems, is fitted with a ½-inch pipe, which will permit a small stream of water to flow through the water-jacket for the purpose of keeping it cool while in operation, and is fitted at a point below the floor with a drip cock, so that the water can all be drained off when not in use.

The sectional cut C—D indicates from another point of view the relative position of the tank, motor, engine, pump and compressor, and this, taken in conjunction with the plan view shows the relatively small area required to install a comparatively large plant.

The only valves used in connection with this system are the foot valve on the suction pipe and the check and gate valve on the discharge from the pump. The check valve is placed near the pump with the gate valve between it and the tank, so that should the former at any time need repairs the latter may be closed off and the check taken apart without emptying the tank.

The system is in every way as complete and thoroughly up-to-date as it is possible to make it, but notwithstanding this, its simplicity and the ease with which it can be installed will appeal to the average plumber, and as will be clear, with the automatic operation of the motor and pump practically no attention, beyond the occasional oiling of the working parts, will be required.

MAPLE SYRUP AS A LUBRICANT.

By Chas. A. Haeussler.

It wouldn't have happened if his name had been an unusual one ; but his name is Brown and he lives in a small town in Michigan. What did happen is told by a motor-boat builder of Detroit. The following is the story given in the American Machinist :

Brown owns a motor boat that he purchased from Charley Arnold, a friend of his who was an agent for that company. The boat had been running fine for several months during the summer and Brown had written several times to say how delighted he was with his new boat. But one day there came a change, in the form of a letter that detailed all the ills to which a motor boat is heir and winding up with a request for immediate information as to what to do to make the motor perform as of yore. Arnold diagnosed the case as well as he could and sent him a bunch of "absent treatment" by return mail. But it was of no use. A telegram stated all the expedients suggested had been tried, but the motor would not "mote." Arnold wired for more symptoms. In reply he received information that the engine, after much cranking, would start, run a few seconds, smoke, spit and emit a terrible stench. "Seems as if it is running hot" ended the telegram. Arnold suggested examining the pump, commutator, carbureter, coil and everything else he could think of and concluded by advising to "Put plenty of oil in the engine." Brown replied "Nothing doing." Then Arnold got him on the telephone.

"What kind of cylinder oil are you using?" "Same as you sent me last week," replied Brown, hotly. "That's good cylinder oil," said Arnold ; "but I cannot understand the engine heating." "Put in some more oil." "Got the case half full now," yelled back Brown. "Well, put in some more," replied Arnold, as he slammed the receiver back on the hook.

In half an hour a telegram told Arnold he could send an expert to make the boat run, or take it back. It was in the middle of the selling season and motor boats were going out at the rate of a dozen a day, so that every competent man was required to tune up the new ones. But there was no way out of it; a man must be sent immediately.

"Half a day to go ; half an hour to make the engine run and another half day to return," growled Arnold. "Wish that fellow could think of one symptom he didn't tell me, so I could tell him what ails his boat."

Man was absent three days. When he returned he met the infuriated manager, who asked : "What on earth kept you so long ; what have you been doing?" "Took his engine all apart ; cleaned it and put it back in." "Why ; what was wrong with it?"

"This," said the man, setting a can of light brown liquid before his chief.

"That looks like good cylinder oil," said Arnold.

"Looks like it ; yes, that's the trouble. It's maple syrup!"

Strange as it may seem, there are two Browns in this Michigan town. A friend had shipped a can of maple syrup to one, on the same day and by the same express company that was carrying the can of cylinder oil from Arnold to the owner of the new motor boat. Cans got mixed en route. When the expert took the motor apart, he found the cylinder full of maple syrup, the bearings full of syrup and the muffler choked with the half-burned wax.

Arnold is now wondering how the other Brown relishes cylinder oil on his pancakes.

THE MISSING LINK.

By F. E. Leonard.

It has been a pleasure to see the advance made in the last three years along the lines of improved construction and management of power development in steam, electricity and gas. These two last factors have been on the power carpet with no uncertain sound, in fact, they are here to stay, as they both will find a place in the forces required to move the world for the benefit of mankind.

Steam was recognized up to a few years ago as the centre around which the world must depend for power of all kinds, and the average steam engineer grew to think very little else could be done towards its development. I do not class electricity as a prime mover in power as its usefulness must either be derived from the steam engine or water fall, but the gas engine is the great rival. Yes, a rival to the steam engine manufacturer, as well as the stationary steam engineer. Why? Because its "introduction does away with that great friend of mankind, the steam boiler, and gives power direct from coal to the public without the steam pump, injector, safety valve, steam gauge and gauge cocks, and last but not least, the 'blow-off cock.'" If there is a mechanical contrivance that wants a holiday, it is that much abused appliance. I will guarantee you gentlemen have heard more sermons and got more lectures from bosses, superintendents, foremen, journeymen and apprentices about the best form and kind, packed and unpacked.

Yes, the gas engine is something all in this room are up against, and at our time of life, it is very hard to be driven to think on different lines, to work out new problems, and witness new results. But the economy of the gas engine as a power maker is now unquestioned, and you and I will have to face the music. Very recently I had a talk with a manufacturer of steam engines from Great

Britain, who informed me they had to add the gas engine to their line of manufacture to hold their trade. I recently conversed with an old stationary engineer, who had had charge of steam engines and boilers for quarter of a century, who had no trouble in mastering the details of a gas engine, and had run one for eleven months without any trouble. When asked how he achieved such results, he said by just watching things and using common sense. This leads me up to the point I would like to make tonight and that is concerning those who are to follow us. Cannot this society do something to encourage the education of the steam, electric or gas engineers, that are to take our places in a few years, cannot we shorten his labor, cannot we make his way smoother and cannot we make him earn better pay by encouraging all plans education on engineering lines? Ontario is blessed with one of the best educational systems in the world, and we tax ourselves freely to put them through the public or high schools. At these junctures three-quarters of them leave the chance of education for ever, and are dumped, yes, cast adrift on the community without oar and rudder. I believe the parents are largely to blame for this, as nine-tenths of them never plan for their offspring's future occupation, but you and I are to blame in a large measure, as we have never supplied the missing link between the public school room and the office or counting room or work shop. We do not strike this human link when it is hot and weldable, generally allowing it to get cold, so much so that the boy cannot take his place in the chain of life's workshop with the grip he should have. He may only become a hewer of wood and a drawer of water with the good education you and I have paid for. This kind of a link at best will only become a poor bread winner. To my mind our trade schools must increase manifold and our factories more apprentices to bring a useful citizen for the future.

Canada produces the best makeup in bone and sinew that is possible on this earth, and Canadians are fast becoming leaders of men. You and I give money by taxes for education without a grumble, but we should do more by argument, influence and votes to place our art schools, trade schools and commercial classes within the reach of every boy and girl in the province. The minister of education should be asked to circulate freely in every industrial centre, knowledge in printed form of the general principles of steam, electric and gas engineering, "For those who are to follow" us.

REAL VALUE OF STEAM COAL.

"In general it may be said that a furnace may be designed to burn almost any kind of coal with good efficiency, and that the real value of a coal depends very largely upon the number of British thermal units which it contains." So states Mr. D. T. Randall, engineer in charge, fuel engineering department, of the Arthur D. Little, Inc. Laboratory of Engineering Chemistry, Boston, Mass., in a recent paper read before the Society of Testing Materials. He points out that "tests which have been made at the Government fuel testing plant seem to indicate that the most important thing to be considered in a coal is its heating value. Following this, the size of the coal may be considered as next in importance, and when the moisture, volatile matter and ash are widely different they must also be considered. The results of more than 400 boiler tests at the Government testing plant show that the average drop in efficiency for a range of coals between 14,000 b.t.u. and 10,000 b.t.u. is only about 6 per cent.

This difference is due to the combined influence of the size of the coal and the moisture, the volatile matter and ash in the coal. It will be seen from these figures that the probable influence of any of these constituents is not as great for hand-fired furnace, as it is often thought to be. With certain boiler equipments in which a considerable over-load is necessary at times, the effects of these constituents may be much more important, owing to the reduction in capacity, which may be obtained, and it is for this reason that when coal is selected for a given plant it is important that the coal supplied should not vary greatly from time to time. Otherwise the fireman may have serious difficulty in maintaining the capacity required, and in burning the coal with good efficiency.

"With a furnace which is well designed, there should be a close correspondence between the heating value of the coal and the water evaporated. Small variations in moisture, volatile matter and ash should make little if any difference in the efficiencies obtained.

"The size of the coal may influence the results to a serious extent. Small sizes of anthracite coal pack together closely and strong drafts are required to burn them. This results in holes in the fire and a leakage of air in the boiler settings. The loss is often estimated to be at least ten per cent. This is also true of many of the bituminous coals. Other coals which coke readily, forming a loose bed of fuel, do not show much loss, due to the presence of fine coal, except such as is so small as to be carried off from the grate by the draft. With any character of coal there may be a loss of fine coal, due to sifting through the grates. That this loss may be large is well known. The carbon in the ash is an important item in determining the losses in a boiler room.

"In many plants care on the part of the firemen has reduced this loss to the equivalent of two and three per cent. of the fuel fired. Occasionally owners of power plants have purchased for testing purposes a coal of higher grade than they usually furnish for the boiler furnaces. The results obtained have often been disappointing and without further investigation they have declared that the plan of purchasing coal on the basis of its heating value is at fault and that corresponding results cannot be obtained from the higher grade coals. On the other hand it has happened that others have tried coals of lower heating value than the coal regularly burned in their plant and they often find a greater drop in the evaporation than they expected. This has led many people to believe that there is a great difference in the value of coals for only slight variations in the composition.

"Boiler tests are a rather crude method of comparing coals especially if the fireman is not accustomed to burning the coal to be tested.

"A chemical laboratory test is conducted under conditions which may readily be duplicated and the results are therefore more reliable than boiler tests.

"The averages of a number of boiler tests on each coal on which the combustion is fairly good in all cases should show results which agree quite closely with the chemical results on the coals provided they are of the same general character. If they vary in composition a slight reduction in efficiency may be expected for the coals high in moisture, volatile matter, and ash."

A German investigator has found that the insulation resistance of coils made from bare aluminium wire depends upon the compression of the wire, and also on its thickness. The smaller the wire, the less its insulation resistance. This he thinks is due to the fact that the thick wires are soft, while thin wires are hard drawn. He also finds that the resistance is considerably reduced while the coils are wet. He therefore suggests that in making coils of bare aluminium wire, the windings should be separated by nonhygroscopic material. Before winding the coils, they should be wet, so as to oxidize the aluminium. After several days they should be dried in a vacuum, and lacquered.

Engineers' Problems

The following questions have been asked by subscribers to The Power House. Readers sending in replies to any of the questions will be paid for the answers. Address replies to the Editor of The Power House, 10 Front St. E., Toronto.

* * *

Asbestos Packing.

In packing an asbestos packed stop cock, should plain asbestos be put in the grooves or should the asbestos be mixed with anything?

WOOLLEN MILL ENGINEER.

* * *

Safety Valve Difficulty.

I have a locomotive in my charge carrying steam at 130 lbs. pressure and equipped with two safety valves set for 130 lbs. When the safety valves blow off, they never close until the steam pressure reduces to 100 lbs. What causes this to happen?

E. V. MOREL.

* * *

Boiler Construction.

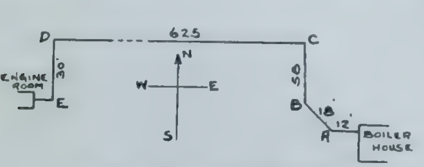
In the April issue of The Power House, I would like to draw your attention to the footnote on page 60 in connection with "The Construction and Inspection of Steam Boilers."

Alberta's new regulations have been in force since Feb. 1, 1910, and copies may be obtained from the government printer, Alberta. In addition to the regulations published, those of Alberta include regulations referring to the efficiency of a segment of a water shell or a water tube, and also working stress on studs and bolts.

THOMAS HARGREAVES.

* * *

Steam Piping Difficulties.



Solving a Steam Piping Difficulty

The enclosed sketch shows the layout of our steam distributing main with which we are having difficulty. This pipe is buried two and a half feet underground, encased in asbestos paper with no other covering. Joints A and B are both half turns, as you will notice, while C and D are both full turns. Joint C is the one with which we are experiencing the most difficulty. A sort of swing joint has been put in at both C and D, and lots of room allowed for expansion. Trouble arises when steam is turned on, as the pipe expands, especially at joint D, and when it is allowed to cool, an equal amount of contraction does not take place to pull the pipe back to its original position, with the result that the pipe is creeping continually towards the west. When it goes so far, it breaks joint C, and now threatens to break D also. In explanation we might say that D is possibly two feet lower than C, owing to the slope of the ground. We were wondering if it would be advisable to take up the pipe, and in place of the abrupt turns at C and D, put in two elbows to make the turn at each place, and put them in a box, allowing plenty of room for expansion. Also put the pipe line from C to D in a tile, which would free it from earth pressure, at the same time place the pipe line from D to E in a box, and allow plenty of room for expansion at that joint also. I would be much obliged if some of our friends in The Power House, would discuss the subject. The firm here does not feel like spending more money on the matter till the opinions of others have been ascertained.

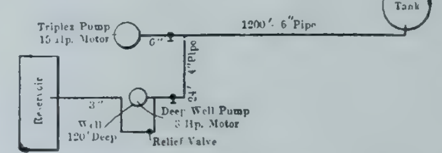
RICHARD BROCK.

* * *

Trouble With Water Supply.

The accompanying diagram shows a layout of water-supply piping for an institution in which I am interested.

The water is pumped by a 7x8-inch Goulds triplex pump operated by a 15-horsepower motor, and is delivered to a tank 75 feet above the ground, through a 6-inch main, 1,200 feet from the pump house. Underground the 6-inch pipe has a fall of 25 feet to the pump, the gage showing a pressure of 42 pounds at the pump. This arrangement works nicely and is in daily operation until 9 p.m., at which time it is shut down until morning.



Layout of Piping

Recently complaints have been made that there is very little water in the tank in the morning. To overcome this difficulty a deep-well pump was put into commission and operated all night to keep up the supply. The pump is 3 inches in diameter by 16 inches stroke and 35 revolutions per minute, and is driven by a three-horsepower motor. The well is supposed to be 120 feet deep. The delivery pipe from this is 4 inches and connects into the 6-inch main from the triplex pump. There is also a 3-inch branch to the reservoir. A relief valve set at 50 lbs. is placed on this branch, to operate in case of the tank becoming full and the ball-cock closed.

From my own observations, when the 4-inch valve from deep-well pump is closed, the relief valve opens and allows the water to discharge into reservoir. When the 4-inch valve is open the pump works easily and does not discharge into the reservoir.

Will this pump deliver water to the elevated tank and in what quantity? There are differences of opinion on this question. The chief engineer claims that it will not work, while the assistant engineer states that he has seen water flowing into the tank. I was not in a position to reach the top of the tank myself, and would like expert opinion on this subject.

D. M. MEDCALF in Power.

BELLEVILLE C. A. S. E. BANQUET.

The Belleville, No. 34 Lodge, C.A.S.E. celebrated the first anniversary of their organization by a banquet, at which W. A. Crocket, the energetic executive secretary made an interesting address. In the early part of the evening, a meeting was held in the lodge rooms, and the members were also addressed at this meeting by Mr. Crocket and also A. White, inspector of boilers, Toronto.

Mr. Crockett referred to the motto of the organization and the educative work of the association. He also referred to the laws which had been enacted in the Province of Ontario in regard to the licenses and the beneficial results of the same.

After the addresses by these two men, the members and visitors repaired to Jas. Wallace's restaurant. After a tempting menu the following list was carried out, F. H. Chesher, the president of the local organization, occupying the chair:—

The King—Responded to by the singing of the National anthem.

Song—"The Old Oaken Bucket," by C. J. Peppin.

C.A.S.E.—W. A. Crockett.

Local, No. 34 C.A.S.E.—Wm Cooke, secretary

Ladies—W. Malloch and Wm. Welsh.

Song—A. Wheeler.

Our Visitors—A. White, J. Stott and D. Osborne.

B. Ketcheson then gave a few remarks regarding the local association, after which a vote of thanks was tendered W. A. Crockett. A pleasant evening was brought to a close by the singing of God Save the King.

POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

British Columbia.

VANCOUVER.—Tenders will be received by W. McQueen, city clerk, up to 3.00 p.m., Tuesday, the 31st of May, 1910, for the installation of a Garbage Destructor Plant at the Bridge Street yard, on the south side of False Creek in the city of Vancouver. The plant must be capable of destroying not less than seventy tons of mixed garbage per day of twenty-four hours. The tendered price is to include the erection of the stack and all necessary buildings.

NELSON.—Fruit growers of the Kootenay district at their recent convention in Nelson, passed resolutions requesting the Canadian Pacific R. R. Co. to establish precooling and icing stations convenient to the district.

VANCOUVER.—The City Dairy & Produce Co. is building a new ice cream factory and cold storage warehouse and will install a 40-ton refrigerating plant with small ice making system. Contract for machinery was let to the Triumph Ice Machine Co., Cincinnati, O.

MERRITT.—At a meeting of the Merritt Electric Light & Water Co. it was decided to install a modern electric lighting system costing over $15,000.

VANCOUVER.—Tenders will be received until May 7th, for the supply, laying and joining of about 72 miles of wire-wound stave pipes; 2½ miles of lap-welded 12-inch steel water pipe; and a supply of sluice, air and scour valves. Cleveland & Cameron, Consulting Engineers, 506 Winch Buildings, Vancouver.

Alberta.

CAMROSE.—M. A. Maxwell, Boston, has been asked to draw plans and specifications for an electric plant. Probable site, north bank of Stoney Creek, east of G.T.R. bridge.

FORT SASKATCHEWAN.—The ratepayers will vote on the expenditure of $10,000 for construction of electric light plant on Sturgeon river. Mr. Lynn, engineer.

HIGH RIVER.—Chipman & Powers, Toronto, have been asked to outline plans for a waterworks system.

MEDICINE HAT.—A. K. Grimmer, formerly city engineer of Fredericton, N.B., and latterly as professor in the Engineering Department of Manitoba University, has accepted the appointment of city engineer.

Saskatchewan.

CARLYLE.—A by-law will probably be submitted to raise $20,000 by debentures for the installation of a water supply.

PRINCE ALBERT.—Sealed tenders addressed to C. O. Davidson, city clerk, and marked "Tenders for Extensions" will be received until noon on Saturday, the 14th day of May, 1910, for the construction of extensions to the water and sewerage systems of the city of Prince Albert, comprising approximately the following work:—4,585 lineal feet 10-inch water main, 984 lineal feet 8-inch water main, 3,395 lineal feet 6-inch water main, 6½ tons special castings, 19 valves, 13 hydrants, 535 lineal feet 24-inch storm sewer, 667 lineal feet 18-inch storm sewer, 580 lineal feet 8-inch storm sewer, 3,056 lineal feet 8-inch sanitary sewer, 13 man holes, 1 flush tank, 1 lamp hole, 16 catch basins.

Manitoba.

WINNIPEG.—Sealed tenders marked on the envelope "Tender for Power House Equipment," will be received at the office of the Commissioners of the Transcontinental Railway, at Ottawa, Ont., until 12 o'clock noon of the 25th day of May, 1910, for the equipment necessary for power house in connection with the shops east of Winnipeg, including water tube boilers, mechanical stokers, feed water heaters, engines, generators, air compressors, pumps. Plans and specifications may be seen in the office of the Chief Engineer of the Commissioners, Gordon Grant, at Ottawa, and in the office of the District Engineer of the Commissioners at St. Boniface, Manitoba.

MINNEDOSA.—The municipality will call for tenders for the construction of a hydro-electric power plant; power, 500 h.p., to be developed from Little Saskatchewan river. C. M. & P. H. Mitchell, Traders Bank Building, Toronto, consulting engineer.

Ontario.

TORONTO.—Tenders will be received by registered post only, addressed to Mayor Geary, up to Tuesday, May 24th, 1910, for the supply and delivery of coal and wood for public buildings and other civic services, from June 1st, 1910, to May 31st, 1911.

LONDON.—A $25,000 lighting plant will be installed in the hospital.

TORONTO.—The Dominion Steam Heating Co. have asked the Toronto Board of Control to have a by-law submitted to the ratepayers on the question of granting a franchise to the company for the laying of steam pipes in the Rosedale district. The company proposes to heat the Rosedale residences from a central plant, and desires to have the question of a franchise decided as soon as possible in order that the steam heating may be in operation by next winter.

TORONTO.—Tenders will be received in triplicate by Darling & Pearson, Toronto, up till noon, Monday, the 23rd inst., for the furnishing and installing all heating and electrical apparatus, constructing tunnels, etc., required for the Central Light, Heat and Power Plant of Toronto University.

STRATFORD.—Tenders are to be called for the $75,000 electric distribution plant for Stratford.

CHIPPAWA.—A by-law to raise $27,000 will be submitted for the installation of a waterworks system.

INGERSOLL.—By-laws to raise $39,000 for the purchase of power plant, etc and another to provide a sum of $15,000 to augment equipment and prepare for distribution of electricity were carried.

LONDON.—The Water Commissioners of London, found that they could pump 247 gallons per lb. of coal. The average static and dynamic was 240 ft., and cost $8.35 per million gallons pumped, or 3½ cents per million gallons raised one foot.

OTTAWA.—Tenders will be received until May 31 for supply and delivery of ten 42 inch cast iron flexible joints. Plans, etc., at office of City Engineer Ker.

NORTH TORONTO.—A by-law authorizing the issue of debentures to the amount of $25,000 to extend the waterworks system, etc., will be submitted on June 4.

WELLAND.—David Dick & Sons have secured contract to build 150 miles of hydro-electric line from St. Thomas to Berlin and Ingersoll to London.

PORT ARTHUR.—Tenders addressed to Hon. Adam Beck, chairman Hydro-Electric Power Commission, Continental Life Building, Toronto, will be received up to 9 a.m. Wednesday, May 25th, 1910, for the construction of transformer station building, superstructure, Port Arthur, all according to plans and specifications to be obtained at the offices of the Commission, Continental Life Building, Toronto, or at the city engineer's office, Port Arthur. Separate tenders for structural steel work will receive consideration.

PORT ARTHUR.—J. J. Antonisen, city engineer, has also been appointed by the city council, commissioner in charge of the public utilities. He will have full executive power over lights, telephones, waterworks, street railway construction, maintenance, power, etc.

Quebec.

MONTREAL.—The city waterworks department will install a new six million gallon turbine pump during the present season at a cost of approximately $30,000.

MONTREAL.—Ross & Greig, representatives in Montreal and district for the Goldie-McCulloch Co.; Sheldon Co., Galt; Garlock Packing Co., Hamilton; Spooners' Copperine, Port Hope, have removed from 325 to 412 St. James Street, where they have secured much larger quarters.

MONTREAL.—The Magnolia Metal Co., 113-115 Bank St., New York, are erecting new offices and factory at 223 St. Ambroise St., Montreal. The factory has been specially designed for their work and it will be ready for occupation in May.

MONTREAL.—The Kent Co., Ltd., will install a 20-ton refrigerating machine in its plant in this city, contract for machinery having been let to the York Manufacturing Co., York, Pa.

MONTREAL.—The Hill Electric Switch Manfg. Co., Montreal, have moved from 1560 St. Lawrence Boulevard, to new premises in McGill Street, number 55.

MONTREAL.—The Allis-Chalmers-Bullock Co., Montreal, will supply the electrical equipment for operating the large flour mill of the Maple Leaf Milling Co., Port Colborne, Ont. The electrical machinery includes transformers of 2,400 kilowatt, or approximately 3,000 horse power, motors (the largest motor being of 700 h.p. capacity), switchboards, etc.

MONTREAL.—The Allis-Chalmers-Bullock, Ltd., manufacturers of electrical, saw mill and hydraulic machinery, have moved their sales offices from the Commercial Union Bldg., to the Canadian Express Company's Bldg., 95 McGill St.

The Rubber Situation.

The Goodyear Rubber Tire & Rubber Co. make the following statement as the result of a trip taken by their president, F. A. Seiberling, to South America to investigate the rubber situation:—"Stories are being circulated to the effect that the rubber supply of the world is being rapidly exhausted, and that the world is facing a famine, but a careful review of the situation justifies an opposite opinion." Mr. Seiberling points out that of the 70,000 tons of crude rubber produced last year, 40,000 tons were wild rubber gathered along the banks of the Amazon, and that with the completion of the railroad to Madeira in 1911 vaster districts will be made accessible to the rubber gatherer. In addition, he says the rubber plantations in the East Indies are now coming into the market and will produce 16,000 tons in 1911, and within five years a quantity larger than that furnished by the Amazon district. Under the circumstances, he concludes that the high price of rubber will prove to be but temporary.

Canadian Dry Docks.

The construction of two immense dry docks and repairing plants, one at Levis, Que., and the other at St. John, N.B., this year, is now assured. A government bill recently introduced at Ottawa provides for the payment of a subsidy of 3½ per cent. of the cost for a term of 35 years on dry docks of not less than 900 feet long. Sir Robert Perks, of the British firm of McArthur, Perks & Co., is one of the leading men behind the enterprise. Sir Robert Perks states that a company is being formed to build the dry docks, on which the Belfast firm of Harland & Wolff will be represented by Lord Pirrie, the Canadian Pacific railway by Sir Thomas Shaughnessy, the Allan Steamship Co. by one of its members, and McArthur, Perks & Co., by himself. Construction work will begin as soon as the subsidy bill is passed. The dry docks will be not less than 900 feet long and 100 feet wide, with a depth of 35 feet on the sill. The plans of the company include the establishment of a large ship building plant at St. John, but details as to this feature have not yet been arranged. The project has been under consideration for some time and is the outcome of the government's policy of having the vessels of the new Canadian navy built in Canada.

The Prevention of Industrial Accidents.

The Fidelity and Casualty Co., New York, mails us a copy of a pamphlet entitled The Prevention of Industrial Accidents. This pamphlet has been prepared by the company for the information of its policy-holders in the various industrial lines. It is estimated that each year from 30,000 to 35,000 wage earners in the United States lose their lives by industrial accidents, and that each year 2,000,000 non-fatal accidents occur in the United States in industrial work. The company's study of the matter, from the data of its own experience and from tabulations made abroad, leads its investigators to believe that possibly 60 per cent. of the accidents in industries are preventable. Having ascertained this deplorable fact, the company has prepared the pamphlet to indicate to operators of works what preventive means can be utilized. The pamphlet is 5¼ by 7¾ inches and has 194 pages. These are freely illustrated. The book is sold by the company at the nominal price of 25 cents.

CATALOGUES.

SAFETY WATER GAUGES.—Catalogue No. 4 from the Northern Specialty Co., Utica, N. Y., describes their self-closing safety water gauges for stationary, heating, locomotive, marine boilers, feed water heaters, oil separators, ammonia tanks, etc. Sectional views are given so that an engineer may thoroughly understand its construction. A postal will bring the catalogue.

WEBSTER HEATING SYSTEM.—A twelve page booklet issued by Darling Bros., Montreal, contains a short description of the Webster system of heating with illustrations of boilers, valves, etc. Of special interest is the diagram showing the results of a test of the Webster system installed in their offices and warehouse, Montreal.

STEAM SPECIALTIES.—Darling Bros., Montreal, have issued a second edition of section XII of their steam specialties catalogue. Among the apparatus illustrated and described are back pressure valves, lubricators, traps, regulating valves, automatic feed pumps, steam separators, oil separators, oil filters, exhaust heads, valve reseating machines, governors, etc.

LUBRICATION AND LUBRICANTS.—The International Acheson Graphite Co., Niagara Falls, have reprinted the paper on this subject, by Chas. F. Mabery, of the Case School of Applied Science, Cleveland. This paper was read before the American Society of Mechanical Engineers and covers the subject thoroughly, tests being given of various bearing and cylinder lubricants.

GREDAG.—A folder from the International Acheson Graphite Co., Niagara Falls, N.Y., tells of Gredag, a combination lubricant made in various grades and consistencies for use in automobile, gears, machinery, etc.

WATER SUPPLY.—A folder from the Lucas Pump Co., Dayton, Ohio, describes the Lucas-Dayton combination pumping outfits for open tank or pneumatic pressure.

GRAPHITE AS A LUBRICANT.—This is the eleventh edition of a treatise upon the theory and practice of graphite lubrication issued by the Joseph Dixon Crucible Co., miners and importers of graphite, plumbago, black lead, etc., Jersey City, N.J. In the seven chapters a fund of information on the subject is given with tests and illustrations.

TURBINE WATER WHEEL.—Catalogue No. 12 of the Canadian Turbine Water Wheel designed and manufactured by Chas. Barber & Sons, Meaford, Ont., 48 pages, printed on coated paper is an attractive publication now being issued by Chas. Barber & Sons. The embossed cover, printed on brown stock in black and green has prominently displayed the trade mark of the firm, "Conserve the Waterpowers." The Canadian Turbine water wheel is installed in a great number of Canadian sawmills, woollen mills, flour mills, power plants, etc., and a partial list of these is given. The water wheel is carefully described and well-selected illustrations show the wheel assembled, in parts and in various installations. The Woodward Governor is also described and tables are given showing the power that may be developed from various heads, with speed, etc. Tables of turbine water wheel costs are included in the catalogue.

GENERATORS.—Economy, low cost of maintenance, simplicity, and ease of control have established direct connected engine type generators as a most desirable link in the chain of transformation from the coal pile to light and power on the customers' premises. For this power to be valuable to the customer—first, its delivery must be absolutely continuous; second, to enable the central station to compete successfully with other forms of power, the efficiency of the generating equipment must be such as to reduce to an absolute minimum the cost of supplying power. To attain both these ends the machine must be constructed of the best materials on the market and must be designed according to the most advanced engineering practice. Bulletin 119 on Large Engine Type D.C. Generators, recently issued by the Crocker-Wheeler Co., of Ampere, N.J., describes generators which contains much useful information for the central station man.

RECORDING THERMOMETER.—Bulletin No. 124 issued by the Bristol Co., Waterbury, Conn., describes one form of Atmospheric Recording Thermometer manufactured by them. This type is extensively used for continuously recording the outside atmospheric temperature, and is only one of the many kinds of recording instruments made by that firm.

PUMPING MACHINERY.—A neat little catalogue has just been issued by the Martin Pump and Machine Co., Toronto, dealing with the various types of feed pumps manufactured by them. It also briefly describes their air and circulating pumps, condensing apparatus, wet and dry vacuum pumps, air compressors, and stationary and marine engines. It is a handy booklet for reference.

BOOK REVIEWS.

DESIGN OF CONDENSING PLANT.—By F. W. Wright. Published by The Technical Publishing Co., Ltd., 55-56 Chancery Lane, London, W.C., 200 pages, 5 x 7½ ins., illustrated. Price 3.6 net.

This book is a well written discussion of condensing apparatus, dealing with subject from its earliest stages, to the latest developments. In order that the book, may be intelligible to the average reader, a chapter is devoted to the consideration of heat units, thereby making the discussion very simple. The book is well written, in a manner quite intelligible to any reader who has the least inkling of the underlying principles. The book fills a long felt want, as, heretofore, no complete work has been written on the subject—most of the information to be had having been dealt with in a minor degree in steam engine treatises. An idea of the scope of the work may be obtained when there are chapters on heat units, jet, ejector, and surface condensers, design of jet and surface condensers, evaporative condensers, water cooling plants, air pump efficiencies, and an appendix describing several typical installations.

"TESTS OF WASHED GRADES OF ILLINOIS COAL" by C. S. McGovney, is issued as Bulletin No. 39 of the Engineering Experiment Station of the University of Illinois. This bulletin presents the results of an elaborate series of boiler tests made in connection with a 210 horse-power brick-set water-tube boiler, equipped with a chain grate stoker. The fuel employed was washed Illinois coal of the various sizes commonly used for steam purposes. The description of the plant, the methods employed, and the results of the tests are given in detail. Copies may be obtained gratis upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

REFRIGERATION.—By Charles Dickerman, Refrigerating Engineer, Pennsylvania Iron Works Co., and Francis H. Boyer, Constructing Engineer, American Society Mechanical Engineers, etc.

A complete guide to the principles and mechanical details and practice of modern systems of artificial cooling, including the construction, equipment and operation of various types of refrigerating plants, such as ammonia compression and absorption, brine, compressed air, carbonic anhydride, etc. 128 pages, 60 illustrations, cloth binding. For sale by the Technical Book Dept. of the MacLean Pub. Co., 10 Front St. E., Toronto. Price $1.00.

TESTS OF TWO TYPES OF TILE-ROOF FURNACES UNDER A WATER-TUBE BOILER.—By J. M. Snodgrass, has just been issued by the Engineering Experiment Station of the University of Illinois as Bulletin No. 34. It consists of a report of eight boiler tests made upon a 210 horse-power water-tube boiler of the Heine type set over a chain grate stoker. In the first four tests the tubes of the lower row of the boiler were completely surrounded by the tile which formed the roof of the furnace; in the last four tests the roof tile rested upon the tubes of the lower row, leaving the lower half of the tubes directly exposed to the flames and hot gases arising from the fire bed. The last four tests show a slightly higher efficiency, more uniform fire control and a lower temperature in the furnace, combustion chamber and stack, than were obtained when the tubes were entirely covered. In the matter of smokelessness, the covered tubes are shown to be superior. Copies of Bulletin No. 34 may be obtained gratis upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

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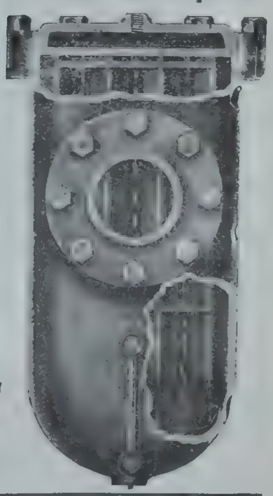

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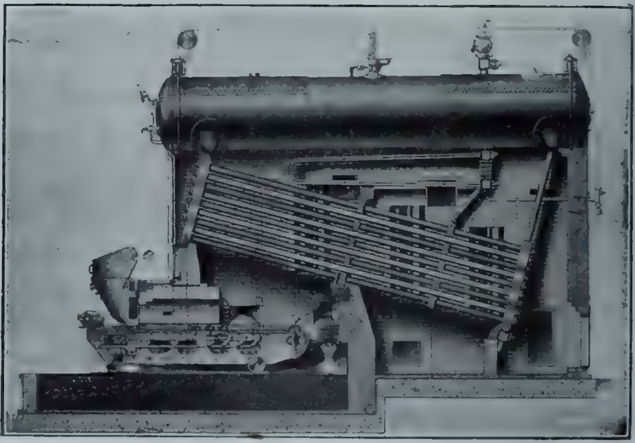

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National Pipe Bending Co., New Haven, Conn.

Blowers.

Canadian Fairbanks Co., Ltd., Montreal
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Canadian Oil Companies, Toronto
Dearborn Drug and Chemical Works, Chicago, Ill.
Electric Boiler Compound Co., Guelph, Ont.
Hygienic Laboratories, Toronto
International Boiler Compound Company, Chicago
Geo. W. Lord Co., Philadelphia
Nichols Chemical Co., Montreal
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Boiler Compound Feeders.

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Boiler Feed Pumps.

Canadian Fairbanks Co., Ltd., Montreal
Canadian Steam Boiler Equipment Co. Toronto
Darling Bros., Montreal

Boiler Feed Regulators.

Automatic Feed and Regulator Co., London
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Canadian Fairbanks Co., Ltd., Montreal
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Power Economy Co., Montreal
Standard Engineering Co., Toronto.

Boiler Feed Water Regulators.

Canadian Fairbanks Co., Ltd., Montreal
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Boiler Mountings.

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Darling Bros., Montreal
The John Inglis Co., Ltd., Toronto
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
Peiler & MacKenzie, Montreal
Standard Engineering Co., Toronto.

Boiler Settings.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Boiler Tube Cleaners.

The Paul B. Huyette Co., Philadelphia.
Liberty Mfg. Co., Pittsburg
Michigan Lubricator Co., Detroit
Peiler & McKenzie, Montreal, Que.
Wm. B. Pierce Co., Buffalo
Power Economy Co., Montreal

Boilers.

Babcock & Wilcox, Montreal
Goldie & McCulloch Co., Galt.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jones Underfeed Stoker Co., Montreal.
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Standard Engineering Co., Toronto
Waterous Engine Works Co., Brantford.

Boilers, Horizontal Tubular.

Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough, Ont.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Boilers, Locomotive

Jno. Inglis Co., Ltd., Toronto
Goldie & McCulloch Co., Galt, Ont.

Boilers, Marine.

Babcock & Wilcox, Montreal
Goldie & McCulloch Co., Galt.
The Wm Hamilton Co., Peterborough.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Boilers, Vertical.

Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Boilers, Water Tube.

Babcock & Wilcox, Montreal
The John Inglis Co., Ltd., Toronto
Polson Iron Works, Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.

Boosters.

Geo. C. Royce, West Toronto

Brine Coolers.

Vilter Mfg. Co., Milwaukee, Wis.

Canners' Machinery.

J. C. Wilson & Co., Glenora, Ont.

Cars, Transfer.

Corbet Foundry and Machine Co., Owen Sound

Castings, Brass.

Hercules Float Works, Springfield, Mass,
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
J. C. Wilson & Co., Glenora, Ont.

Cement Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
Jno. McDougall Caledonian Iron Works, Montreal

Chain Drives.

Jones & Glassco, Montreal
John Millen & Sons, Montreal

Chemicals.

Dearborn Drug and Chemical Works Chicago
Nichols Chemical Mfg. Co., Montreal

Circuit-Breakers.

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Coal and Ash Conveyors.

Babcock & Wilcox, Montreal
Peiler & McKenzie, Montreal, Que.

Coal Handling Machinery

Standard Engineering Co., Toronto

Cold Storage Architects.

E. J. Greenstreet, Toronto

Condensers.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
J. P. Devine Co., Buffalo, N.Y.
Goldie & McCulloch Co., Galt.
Jno. Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Peiler & McKenzie, Montreal, Que.
Vilter Mfg. Co., Milwaukee, Wis.

Consulting Engineers.

Bain & Mitchell, Montreal
Bayfield & Archibald, Vancouver, B.C.
de Gaspe Beaubien, Montreal.
Rowland Brittain, Vancouver, B.C.
W. S. Brooke, Toronto
Cleveland & Cameron, Vancouver, B.C.
Dutcher & Foreman, Vancouver, B.C.
John T. Farmer, Montreal
Walter J. Francis, Montreal.
J. F. Frew, Vancouver, B.C.
Galt & Smith, Toronto.
E. J. Greenstreet, Toronto
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Laurie & Lamb, Montreal
Marchand & Donnelly, Ottawa, Ont.
Ralph D. Mershon, Montreal
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John B. McRae, Ottawa
Morris Engineering Co., Vancouver, B.C.
J. M. Robertson, Montreal.
J. M. Shanly, Montreal.
Standard Engineering Co., Toronto
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Contractors, Structural Steel

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Conveyor Machinery.

Canadian Fairbanks Co., Ltd., Montreal
Jno. McDougall Caledonian Iron Works, Montreal

Cork Insulation.

Canadian Fairbanks Co., Ltd., Montreal
Linde British Refrigeration Co., Montreal

Couplings.

Canadian Fairbanks Co , Ltd , Montreal
J. C. Wilson & Co., Glenora, Ont.

Cranes, Electric.

Babcock & Wilcox, Montreal
Jno. McDougall Caledonian Iron Works Montreal

Crank Pins.

Michigan Lubricator Co., Detroit
Sight Feed Oil Pump Co., Milwaukee, Wis.

Cross Head Pins.

Michigan Lubricator Co., Detroit
Sight Feed Oil Pump Co., Milwaukee, Wis

Crushing Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal

Damper Regulators.

Darling Bros., Montreal
Julian d'Este Co., Boston, Mass.
Peiler & MacKenzie, Montreal
Standard Engineering Co., Toronto

Dredges.

Allis-Chalmers-Bullock, Ltd., Montreal

Drills, Rock.

Allis-Chalmers-Bullock, Ltd., Montreal

Drying Machinery.

Canadian Fairbanks Co., Ltd., Montreal
J. P. Devine Co., Buffalo N.Y.
Jno. Inglis Co., Ltd., Toronto

Dynamos.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd , Montreal
Canadian Westinghouse Co., Hamilton
Mechanical & Elec. Lab., Buffalo
Electrical Maintenance & Repair Co., Toronto.

Economizers.

Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal

Electric Power Instalations.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton

Electrical Accessories.

Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Toronto

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Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Toronto

Electrical Repairs.

Electrical Maintenance & Repair Co., Toronto.
Northern Electric Supply Co., Orillia, Ont.

Elevating Machinery.

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Goldie & McCulloch Co., Galt.
The John Inglis Co., Ltd., Toronto
Waterous Engine Works Co., Brantford

Engines, Automatic.

The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works Montreal
Robb Engineering Co., Amherst, N.S.

Engines, Corliss.

Allis-Chalmers-Bullock, Ltd., Montreal
Goldie & McCulloch, Co., Galt.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S
Vilter Mfg. Co., Milwaukee, Wis.

Engines, Gas and Gasoline.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Drummond, McCall & Co., Montreal
Fielding & Platt, Ltd., Gloucester, Eng.
Jno. McDougall Caledonian Iron Works, Montreal

Engines, High Speed, Steam.

Goldie & McCulloch Co., Galt.
The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Engines, Marine

Canadian Fairbanks Co., Ltd , Montreal
Jno. Inglis Co., Ltd., Toronto

Engines, Medium and Low Speed.

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The John Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Rocking Valve.

The John Inglis Co., Ltd., Toronto

Engines, Saw Mill.

Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough.
The John Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Bran ford

Engines, Single, Compound and Triple Expansion.

Drummond, McCall & Co., Montreal
The Wm. Hamilton Co., Peterborough.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal
Jno. McDougall Caledonian Iron Works, Montreal
Kerr Engine Co., Walkerville
Robb Engineering Co., Amherst. N.S.
Waterous Engine Works Co., Brantford

Engines, Slide Valve

Jno. Inglis Co., Ltd., Toronto

Engines, Vertical.

The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.

Exhaust Heads.

Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
Standard Engineering Co., Toronto.
Watson & McDaniel Co., Philadelphia

Feed Water Alarms.

Peiler & McKenzie, Montreal, Que.
Reliance Gauge Column Co., Cleveland, Ohio

Feed Water Analyser.

Dearborn Drug and Chemical Works, Chicago

Feed Water Heaters

Babcock & Wilcox, Montreal
Canadian Fairbanks Co , Ltd., Montreal
Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
Goulds Pump Co , Montreal
The Wm. Hamilton Co , Peterborough.
The John Inglis Co., Ltd., Toronto
C. Jacobs & Co., Boston, Mass.
National Pipe Bending Co., New Haven, Conn
Peiler & MacKenzie, Montreal
Robb Engineering Co., Amherst, N.S.
Standard Engineering Co , Toronto
The Stewart Heater Co., Buffalo, N.Y.

Feed Water Regulators

Liberty Mfg. Co., Pittsburg, Pa.
Peiler & McKenzie
Power Economy Co., Montreal

Filters, Pressure

Jno. McDougall Caledonian Iron Works Montreal

Fire Brick.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Flanges

Dart Union Co., Toronto

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Corbet Foundry and Machine Co., Owen Sound
The Wm. Hamilton Co., Peterborough
The John Inglis Co., Ltd., Toronto

Furnace Linings.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Fuses.

Geo. C. Royce, West Toronto

Gas Producer Linings.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Gas Producer Plants.

Bain & Mitchell, Montreal
Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Drummond, M Call & Co., Montreal
Fielding & Platt, Ltd., Gloucester, Eng.

Gauge Cocks.

Canadian Fairbanks Co., Ltd., Montrea
The Paul B. Huyette Co , Philadelphia
Peiler & McKenzie, Montreal, Que.
Reliance Gauge Column Co., Cleveland, Ohio

Gauges, Pressure, Vacuum and Recording.

Babcock & Wilcox, Montreal
Lunkenheimer Co., Cincinnati, Ohio
Peiler & MacKenzie, Montreal

Gears, Angle.

The Wm Hamilton Co , Peterborough
Jno. McDougall Caledonian Iron Works, Montreal
J. C. Wilson & Co., Glenora, Ont.

Gears, Cut.

J. C. Wilson & Co., Glenora, Ont.

Gears, Mortise.

J. C. Wilson & Co., Glenora, Ont.

Gears, Reducing

Jno. McDougall Caledonian Iron Works, Montreal

Gears, Worm.

J. C. Wilson & Co., Glenora, Ont.

Generators.

Allis-Chalmers-Bullock, Montreal
Canadian Electrical & Motor Co., Toronto
Canadian Fairbanks Co., Ltd , Montreal
Cana ian Westinghouse Co Hamilton
Chapman & Walker, Ltd. To

Governors.

Allis-Chalmers-Bullock, Ltd., Montreal

Governors, Water Wheel.

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Grates.

Babcock & Wilcox, Montreal
Butterworth Foundry Co., Ottawa
Canadian Steam Boiler Equipment Co. Toronto
eiler & McKenzie, Montreal, Que.
Diamond Grate Bar Co., Berlin, Ont.
The John Inglis Co., Ltd., Toronto
Power Economy Co., Montreal

Gravity Closing Ventilators.

Standard Engineering Co., Toronto.

Grease Cups.

Detroit Lubricator Co., Detroit.
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
Power Economy Co., Montreal

Grease and Oil Extractors.

C. Jacobs & Co., Boston, Mass.

Greases

Canadian Fairbanks Co., Ltd., Montreal
Canadian Oil Companies, Toronto
Electric Boiler Compound Co., Guelph.

Hangers.

Canadian Fairbanks Co., Ltd., Montreal
Goldie & McCulloch Co., Galt.
Jno. McDougall Caledonian Iron Works, Montreal
Waterous Engine Works Co., Brantford
J. C. Wilson & Co., Glenora, Ont.

Head Protectors.

Vinton Co., New York, N.Y.

Heaters.

Darling Bros., Montreal
Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co , Peterborough
The John Inglis Co., Ltd., Toronto
Peiler & McKenzie, Montreal. Que.
The Stewart Heater Co., Buffalo, N.Y.

Hydraulic Accumulators.

The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

Hydraulic Machinery.

The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

Ice Making Machinery.

Linde British Refrigeration Co., Montreal
Vilter Mfg. Co., Milwaukee, Wis.

Indicators. Electric—All Types.

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Indicators, Steam Engine.

Canadian Fairbanks Co , Ltd., Montreal
Peiler & MacKenzie, Montreal

Indicators, Water.

Detroit Lubricator Co.. Detroit

Injectors.

Detroit Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati. Ohio
Jas. Morrison Brass Mfg. Co., Toronto
Penberthy Injector Co., Windsor.

Lamps, Arc.

Canadian Fairbanks Co., Ltd , Montreal
Canadian Westinghouse Co., Hamilton

Lamps, Incandescent

Canadian Westinghouse Co., Hamilton
Chapman & Walker, Toronto

Lubricants.

Jos. Dixon Crucible Co., Jersey City

Lubricators, Force Feed.

Darling Bros., Montreal
Detroit Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati
Michigan Lubricator Co., Detroit
Sight Feed Oil Pump Co., Milwaukee, Wis.

Lubricators, Plain.

Detroit Lubricator Co., Detroit

Maple Cogs.

The Wm. Hamilton Co , Peterborough
J. C. Wilson & Co., Glenora, Ont.

Mechanical Stokers.

Babcock & Wilcox, Montreal
Jones Underfeed Stoker Co., Montreal.
Standard Engineering Co., Toronto

Meters, Electric

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Meters, Water

Drummond, McCall & Co., Montreal
Peiler & MacKenzie, Montreal

Mill Machinery.

Allis-Chalmers-Bullock, Ltd., Montrea
Canadian Fairbanks Co., Ltd., Montreal
Goldie & McCulloch Co., Galt.
The Wm Hamilton Co., Peterborough
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
Madison Williams Mfg, Co., Lindsay, Ont
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford
J. C. Wilson & Co., Glenora, Ont.

Mining Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
The Wm. Hamilton Co., Peterborough
Jno. Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

Motors.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Electrical Maintenance and Repair Co. Toronto.

Motor Controllers.

Canadian Westinghouse Co., Hamilton

Motor Starters.

Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Geo. C. Royce, West Toronto

Oilers, Gang.

Michigan Lubricator Co., Detroit
Sight Feed Oil Pump Co., Milwaukee, Wi

Oilers, Multiple.

Detroit Lubricator Co., Detroit

Oil Filters

Darling Bros., Montreal
Liberty Mfg. Co., Pittsburg, Pa.
Power Economy Co., Montreal

Oil and Waste Saving Machines.

Canadian Oil and Waste Saving Machine Co., Brockville, Ont.

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Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal
Canadian Steam Boiler Equipment Co., Toronto
Darling Bros.. Montreal
C. Jacobs & Co., Boston, Mass.
Liberty Mfg. Co., Pittsburg
Peiler & MacKenzie, Montreal
Power Economy Co., Montreal
Standard Engineering Co., Toronto

Oils, Lubricating.

Canadian Oil Companies, Toronto
Dearborn Drug and Chemical Works, Chicago
Electric Boiler Compound Co., Guelph Ont.

Packing, Leather.

Electric Boiler Compound Co., Guelph Ont.
Garlock Packing Co., Hamilton

Packing, Metallic.

Peiler & McKenzie, Montreal, Que.
Power Economy Co., Montreal

Penstocks.

The Wm. Hamilton Co., Peterborough
Jno. Inglis Co., Ltd., Toronto

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Curtis & Curtis Co., Bridgeport, Conn.

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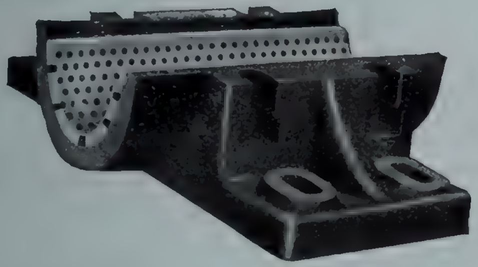

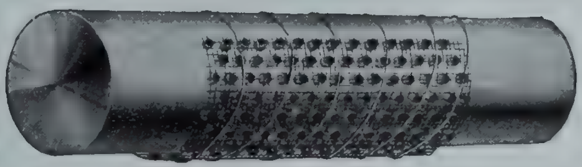

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Babcock & Wilcox, Montreal
Drummond, McCall & Co., Montreal

Planimeters.

Peiler & MacKenzie, Montreal

Plate Work.

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Jno. McDougall Caledonian Iron Works, Montreal

Pumping Machinery.

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Jno. Inglis Co., Ltd., Toronto

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Canadian Steam Boiler Equipment Co. Toronto
Darling Bros , Montreal
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Liberty Mfg. Co., Pittsburg, Pa.
Peiler & MacKenzie, Montreal
Standard Engineering Co., Toronto.
Watson & McDaniel Co. Philadelphia

Pump Regulators.

Peiler & McKenzie, Montreal

Pump Strainers.

Canadian Steam Boiler Equipment Co., Toronto
Liberty Mfg. Co., Pittsburg, Pa.
Power Economy Co., Montreal

Pumps, Air,

Canadian Fairbanks Co., Ltd., Montreal
The John Inglis Co., Ltd., Toronto
Lunkenheimer Co., Cincinnati, Ohio

Pumps, Centifrugal

Jno. Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

Pumps, Geared

Canadian Fairbanks Co., Ltd., Montreal
Jno. Inglis Co., Ltd., Toronto

Pumps, Oil.

Detroit Lubricator Co., Detroit
Michigan Lubricator Co., Detroit
Sight Feed Oil Pump Co., Milwaukee, Wis.

Pumps, Steam

Canadian Fairbanks Co., Ltd., Montrea
The John Inglis Co., Ltd., Toronto
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Recorders.

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Linde British Refrigeration Co., Montreal
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Peiler & McKenzie, Montreal

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Peiler & MacKenzie, Montreal

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Peiler & MacKenzie, Montreal

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The Wm. Hamilton Co., Peterborough
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Corbet Foundry and Machine Co., Owen Sound
The Wm. Hamilton Co., Peterborough
The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

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Canadian Fairbanks Co., Ltd., Montreal
Electrical Maintenance and Repair Co. Toronto.
The John Inglis Co., Ltd., Toronto

Sprocket Wheels.

J. C. Wilson & Co., Glenora, Ont.

Spur Wheels.

Canadian Fairbanks Co., Ltd , Montreal
J. C. Wilson & Co., Glenora, Ont.

Stand Pipes, Steel.

The Wm. Hamilton Co., Peterborough
The John Inglis Co., Ltd., Toronto

Steam Pumps.

Darling Bros., Montreal
The John Inglis Co., Ltd., Toronto
Goldie & McCulloch Co., Galt.

Steam Separators.

Canadian Fairbanks Co., Ltd., Montreal
Darling Bros., Montreal
Julian d'Este Co., Boston, Mass.
Ideal Steam Separator & Supply Co., Toronto
Liberty Mfg. Co., Pittsburg, Pa.
Peiler & McKenzie, Montreal
Power Economy Co., Montreal
Watson & McDaniel Co., Philadelphia

Steam Specialties.

Darling Bros., Montreal
Julian d'Este Co., Boston, Mass.
Ideal Steam Separator & Supply Co., Toronto
Liberty Mfg. Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, Ohio
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Penberthy Injector Co., Windsor.
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Darling Bros., Montreal
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Ideal Steam Separator & Supply Co., Toronto
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Morehead Mfg. Co., Detroit, Mich.
Peiler & MacKenzie, Montreal
The Power Economy Co., Montreal
Reliance Gauge Column Co., Cleveland, Ohio
Russell & Gifford, Toronto
Standard Engineering Co., Toronto
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Strainers.

Liberty Mfg. Co., Pittsburg, Pa.
Power Economy Co., Montreal

Superheaters, Steam,

Babcock & Wilcox, Montreal

Switchboards, Light and Power.

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Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Electrical Maintenance and Repair Co. Toronto.
Geo. C. Royce, West Toronto

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Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Tanks, Blow-off

Darling Bros., Montreal
The John Inglis Co., Ltd., Toronto

Tanks, Oil.

Goldie & McCulloch Co., Galt.
The John Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Sight Feed Oil Pump Co., Milwaukee, Wis.
Waterous Engine Works Co., Brantford.

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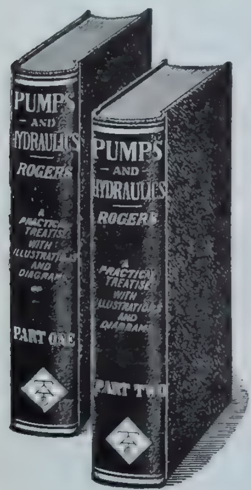
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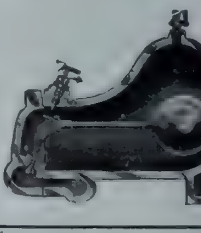

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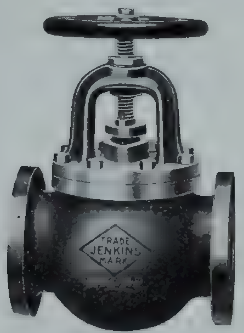

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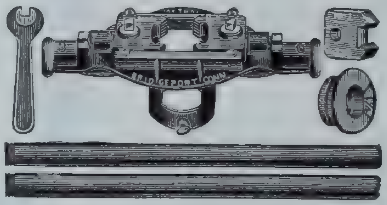

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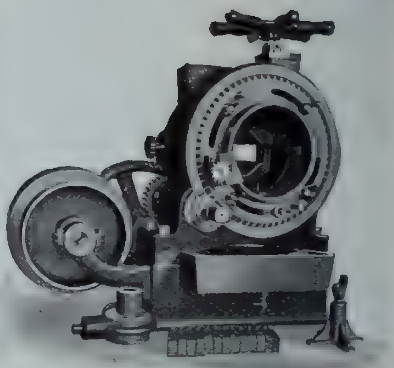

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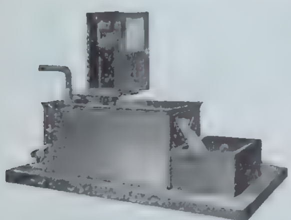

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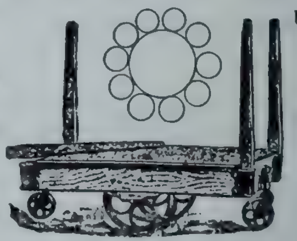

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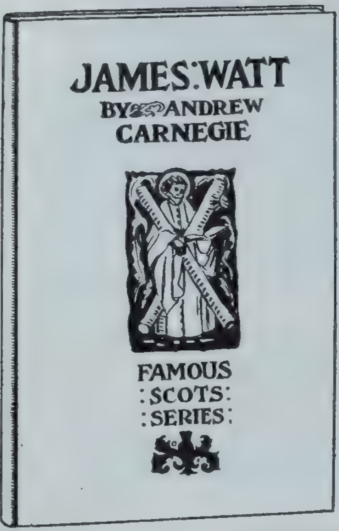

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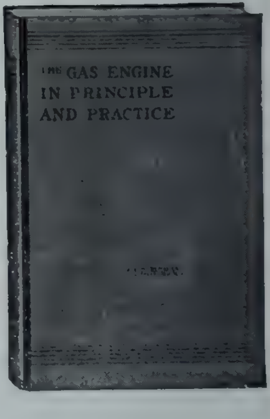

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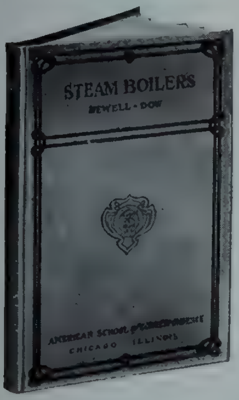

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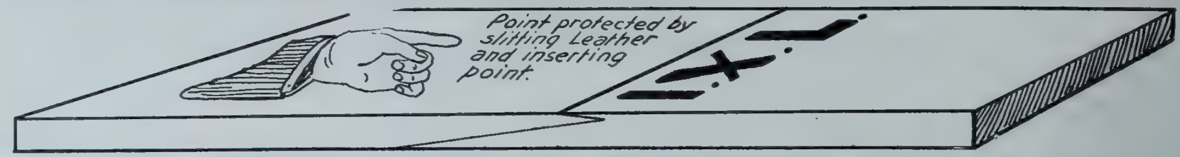

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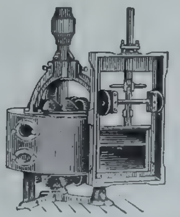

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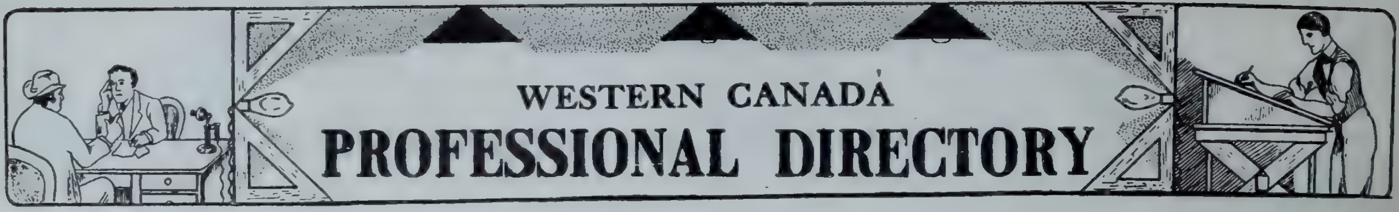

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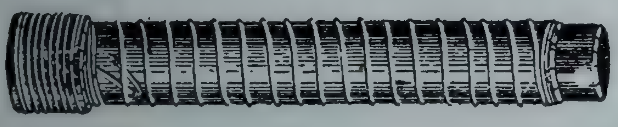

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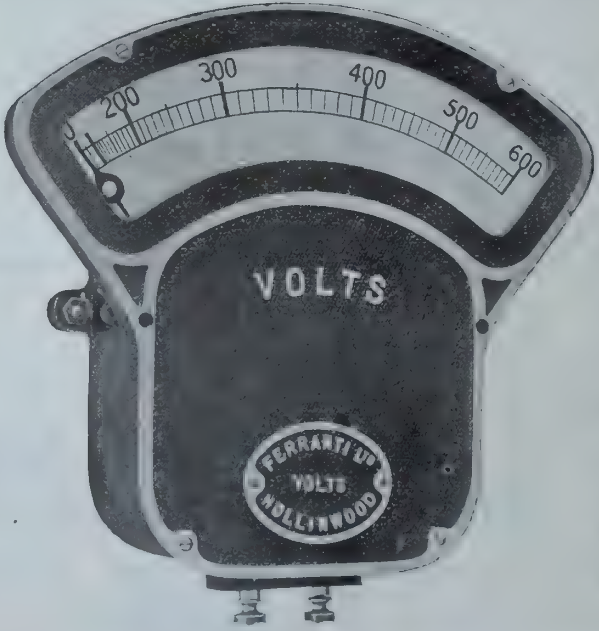

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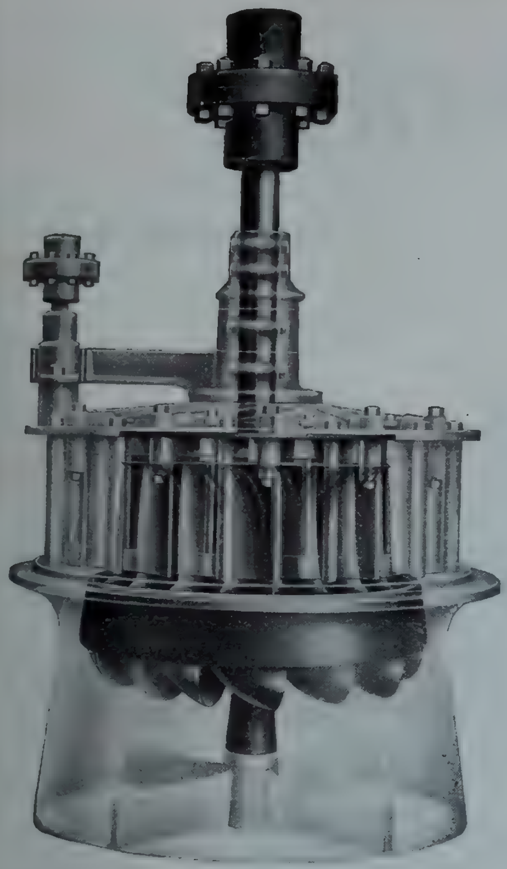

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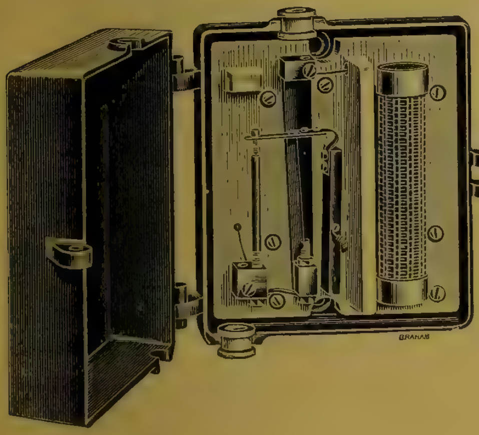

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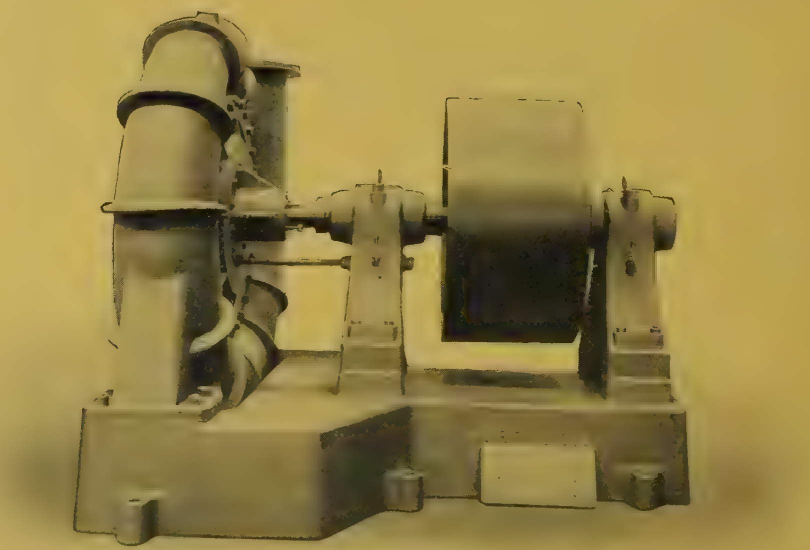

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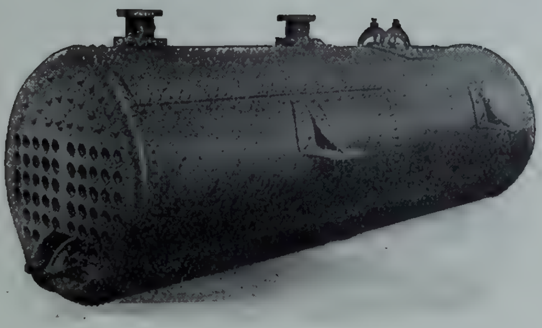

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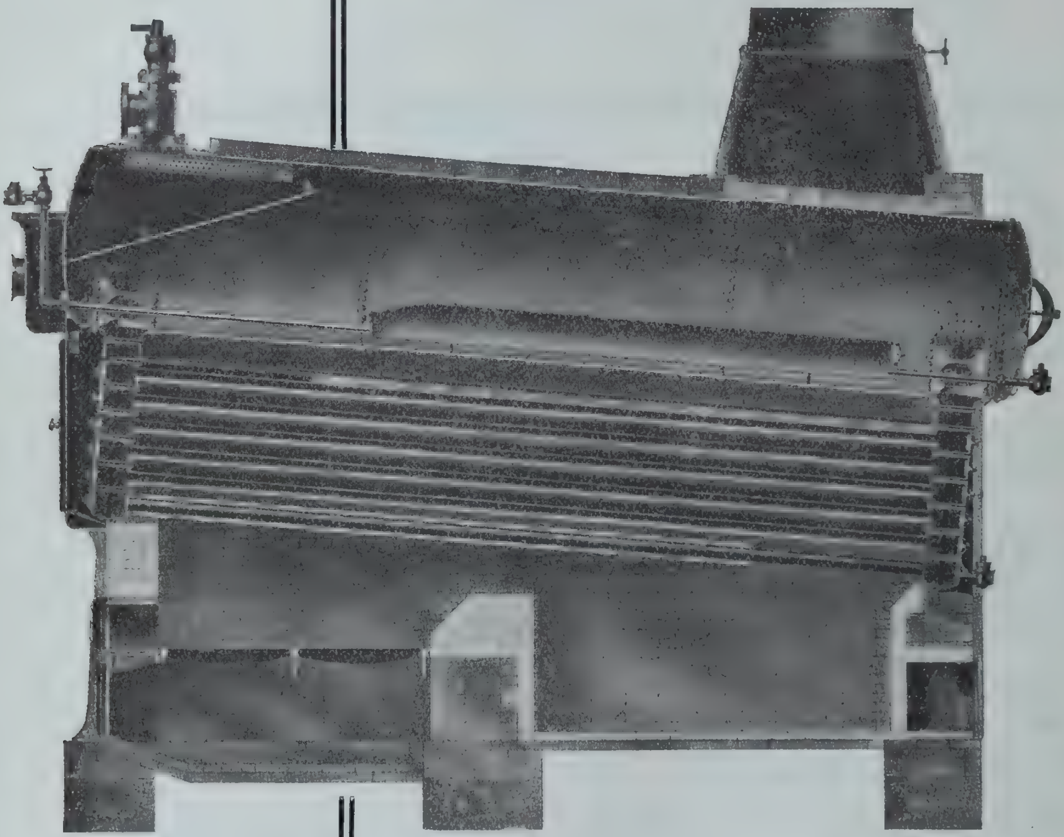
Over 125,000,000 H.P. of Heine Boilers in use in the United States.

Here's a strong statement!

But one to the truth of which thousands of Power Plant Owners can testify!

In point of ECONOMY, EFFICIENCY, SAFETY and DURABILITY the best on the market for every size plant is the

HEINE SAFETY BOILER



¶ Its economy and capacity are determined by the fact that it is the best boiler for rapidly absorbing and transmitting heat; moreover, it separates the water from the steam, thus ensuring dry steam at the piston.

¶ Another feature is the HEINE DRUM, which effectively precipitates and discharges all scale and mud from the boiler.

¶ The HEINE BOILER will hold high pressures with safety because of the careful selection of raw materials, the skill employed in every detail of its manufacture, and the numerous severe tests to which it is subjected, both during the making and after it has been put together as a completed boiler.

As an actual or prospective buyer you are invited to make the fullest enquiries.

Polson Iron Works, Ltd.

Toronto, Ont.

Agents for Quebec—Watson Jack & Co., 709 Power Bldg., Montreal.

Our Literature will interest every user of Steam.

Send for it to-day.

BOILERS

Horizontal Tubular
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Locomotive Types
Medium and High Pressures
All Sizes
Heating Boilers
Complete Steam Power Plants
Write us for Quotations
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The Jenckes Machine Co., Limited

WORKS:

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Kindly address nearest Sales Office.

"THE Cyclone"

Shaking and Dumping Grate Bar

This is the Grate Bar that will generate more steam from the amount of fuel consumed than any other grate in the world. It is the one grate from which you can get the maximum results from such cheap fuel as Soft and Hard Coal Screenings, Hard or Run-of-mine Coal, etc.

The reason is very simple. The construction of the "CYCLONE" Bar allows 68 per cent. of air space and 90 per cent. underdraught. It has greatly improved shaking mechanism that keeps it absolutely free from clinkers and prevents any waste of fuel.

The "Cyclone" locks level; cannot get out of adjustment; will never warp.

We can show you scores of highly appreciative letters from well-known business houses of which the one printed here is typical. *Read it :*

Why continue using an inferior and less economical grate when the

"*Cyclone*"

is at your service? Write us to-day for our illustrated circular.

> Canadian Steam Boiler Equipment Co.
> Toronto.
>
> GENTLEMEN:
>
> We are sending you to-night, through our Head Office in Montreal, an order for another set of Cyclone shaking and Dumping Grate Bars for one of our boilers. We are glad to say that we have no reason whatever to regret the installation of the first set of these bars. We have now had them in operation several months, and we find that we get more perfect combustion and much better fires and greater economy in our use of coal with these bars than we have had from any system of firing that we have tried at this Mill. It is our intention, during the coming summer months, to complete the installation of these grate bars under our other four boilers.
>
> Yours truly,
> The Canadian Colored Cotton Mills Co.
> Ltd., St. Croix Mill.
> J. W. GRAHAM, Manager.

Canadian Steam Boiler Equipment Co., Limited

(Sole Manufacturers for Canada)

186 Queen Street East, - TORONTO

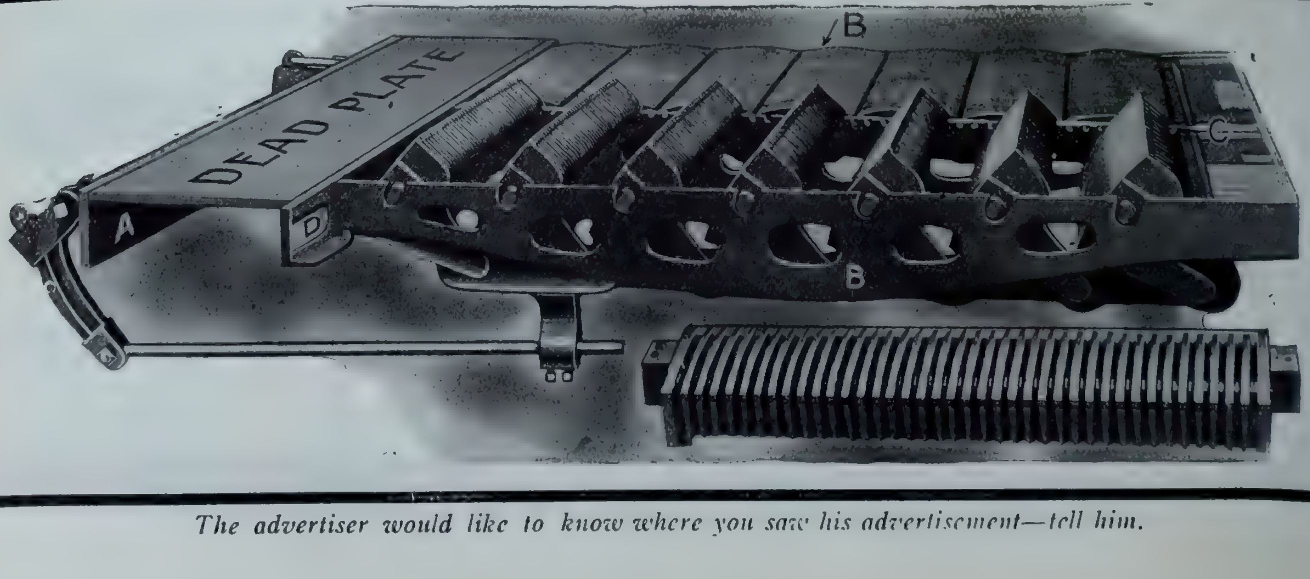
AGENTS:

ST. JOHN, N.B.—F. W. BLIZZARD, Canada Permanent Chambers.

MONTREAL—LOWDEN & MEAD, 18 Bleury Street

HAMILTON—ROBT. FITZSIMMONS, 8 Grove Street

WINNIPEG—GREEN & LISTER, Heating Engineers.

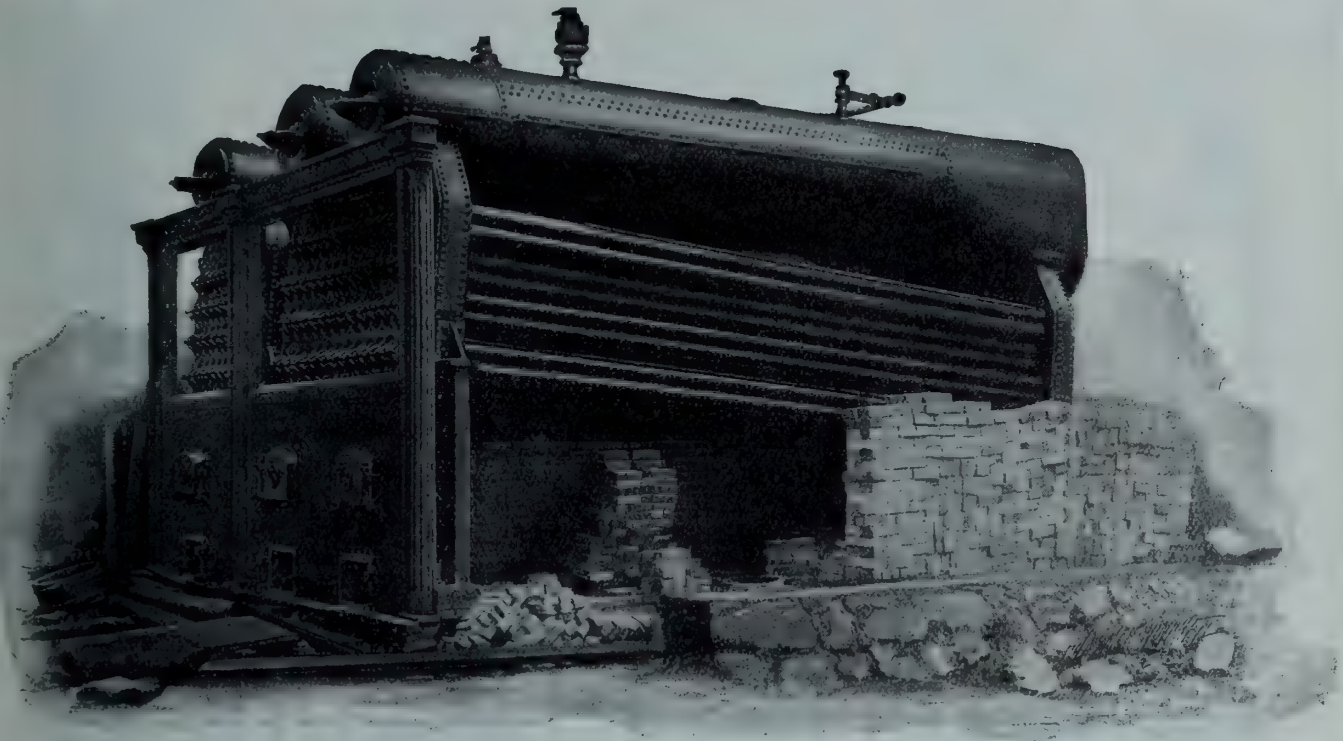


ERIE CITY WATER-TUBE

BOILERS

Vertical and Horizontal

SAFE --- DURABLE --- ECONOMICAL --- EFFICIENT



ERIE CITY WATER-TUBE BOILER, with three drums, ready for Masonry.

Erie City water-tube boilers are "**Safe,**" "**Durable**" and "**Economical,**" because they are properly designed and built in the beginning, and the very correctness of that design eliminates the actual causes that lead other boilers to fail, give out and be condemned. We do not measure efficiency solely from the coal pile, but use the term in its broadest sense as applied not only to the product of steam at a given rate, but taking into consideration capacity, freedom from repairs and unusual expense for keeping clean. We claim that at the end of a year, or any extended period, our boiler will not only have furnished more steam per pound of coal, but that the boiler will stand charged with less expense for repairs and delays than any other water-tube boiler now offered in the market.

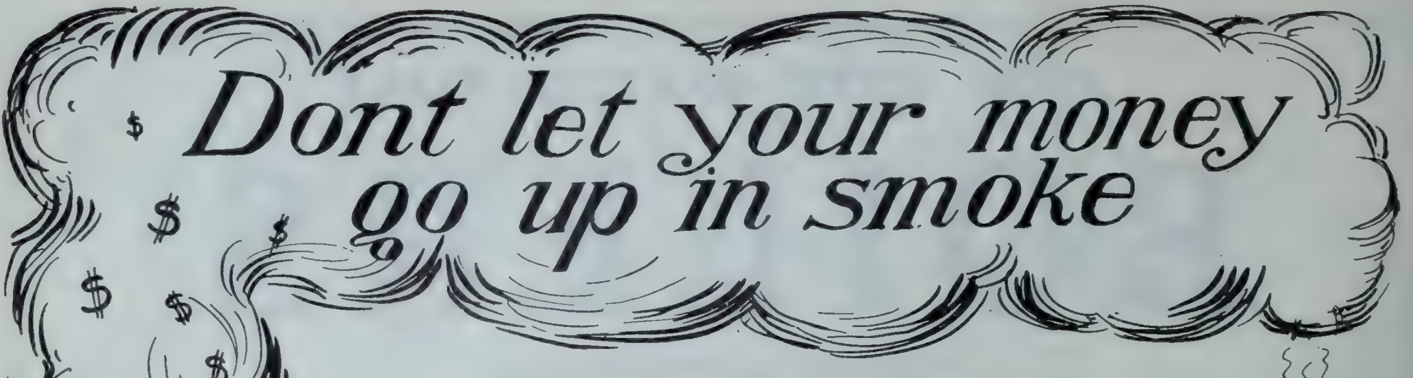
Write us for catalogue, prices, etc.

THE JOHN INGLIS COMPANY, LTD.

ENGINEERS AND BOILER MAKERS

Canadian manufacturers of Erie City Water-Tube Boilers

14 Strachan Avenue, - - - - TORONTO, Canada


Dont let your money go up in smoke

THE COST OF SMOKE

¶ What proportion of the coal fed to the locomotive is actually used in power?

¶ About 6 per cent.; the rest is wasted.

¶ What part of the fuel value of their coal do the furnaces of the great manufacturing plants actually apply to driving the machinery?

¶ Not over 10 per cent.; often less.

¶ The rain of cinders from the locomotive, the pillar of black smoke from the factory chimney, account conspicuously for the waste. The great loss, however, is in the form of unconsumed gases which escape into the air without having been of any steam-producing value.

¶ These gases escape because, as is well known, perfect combustion has never been discovered as yet. The gases escape from the coal so rapidly that, before they are mixed with the necessary air (providing oxygen) they have passed away from the point of combustion—which is at the surface of the burning coal.

¶ The rescue of a small proportion of the 90 per cent. of fuel value thus wasted would mean a large proportion of the 10 per cent. now ordinarily used.

¶ This should be easily done.

¶ It has been done, and is being done. It can be done in every plant—in yours with the rest. Chemistry has produced in the *FISHER FUEL ECONOMIZER* a substance which when applied to the coal forms an exceedingly thin film over it and causes the valuable heat-producing gases to be held in the coal itself, and the coal and the gases are consumed together, thus preventing the waste of valuable gases which take place when the coal is consumed without the treatment.

¶ Indisputable evidence is available that by the use of

FISHER FUEL ECONOMIZER

Black smoke and flying cinders are eliminated, which has been proved on locomotives pulling the fastest passenger as well as the heaviest freight trains. Many evaporation tests in the power plants of the largest corporations in Canada show increase of efficiency ranging from 10 to 25 per cent.

¶ We save money for the factory owner and railway.

¶ We save the fireman much hard and dirty work.

¶ We save the black smoke which pollutes the air.

¶ We reduce your ashes and clinkers half.

¶ We increase and maintain steam to a degree which is impossible without the economizer.

¶ We keep your boiler tubes and grate bars clean, reducing expense of upkeep.

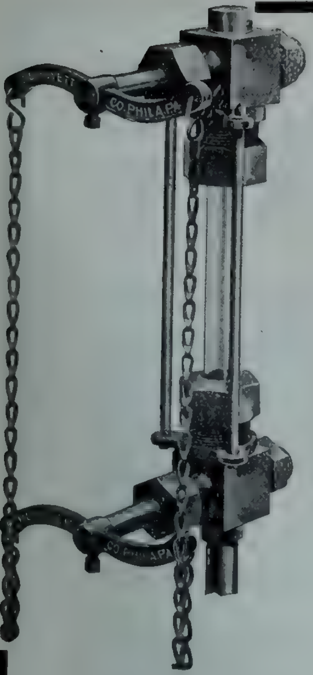
Let Us Prove It to You. Write To-day for Information

Phone Main 2390

Fisher Fuel Economizer Limited

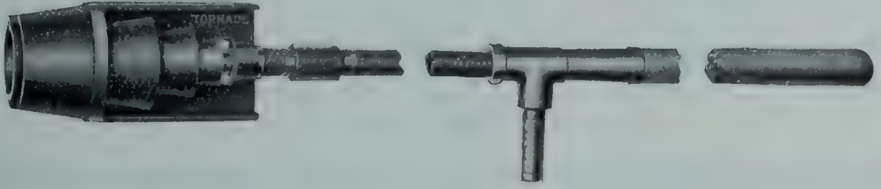
Head Office, 74 Bay St., Toronto, Ont.

MONTREAL	OTTAWA	WINNIPEG
212 St. James Street	**35 Mackay Street**	**310 McGreevy Block**
Phone Main 3497	*Phone 1879*	*Phone Main 2750*



If You Desire To Save Troubles In Your Boiler Room—Use

The ***"P.B.H."*** QUICK-CLOSING WATER GAUGE is an accident insurance against scalds and burns. If the glass breaks, a pull of the chain shuts off both the steam and water. Its structure is perfect; extra heavy body, best steam metal with extra large nuts for extra heavy washers. Less than a quarter turn of stem fully closes or opens valves. ***Sent on trial.***



The ***"TORNADO"*** STEAM BOILER TUBE CLEANER not only does the work better than any other cleaner but does it in shorter time and more economically. Because the air injected by a small volume of steam carries no moisture to wet the soot, but blows it out through the longest tubes. **Sent on trial.**

The ***"P. B. H."*** QUICK OPENING, SELF-CLOSING GAUGE COCK; it is simple, efficient, economical and quickly repaired. It combines all the mechanical perfections which make it a GAUGE COCK. GUARANTEED LEAKLESS for years. ***Sent on trial.***

We also make the Mather Boiler Blow-off Pipe Protector. Have you seen it? Do you know what it is?

WRITE FOR CATALOGUE

The *Paul B. Huyette Co., Inc.*

1414 BETZ BUILDING, PHILADELPHIA, PA.

Selling Agents for Western Ontario and Northwest:
Canadian Steam Boiler Equipment Co., 186 Queen St. East, Toronto

Selling Agents for Province of Quebec and Eastern Ontario:
Peiler & MacKenzie, 52 St. James Street, Montreal, Canada

Selling Agents for Maritime Provinces and Newfoundland:
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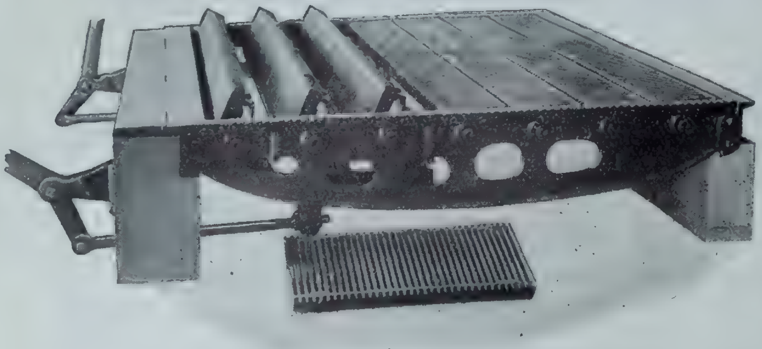
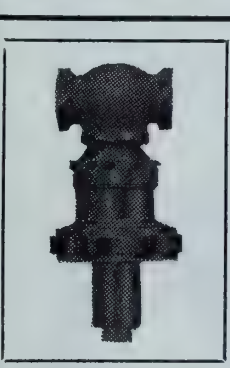
"CAPITAL" SHAKING AND DUMPING GRATE

PATENTED 1910



A comparison of this grate with other shaking grates will show many advantages; the bearings are 3½ inches below the fire, thus ensuring against their burning out rapidly, the sections are easily removed and replaced at low cost, easily operated, greater air space. Send for particulars to

Butterworth Foundry, Limited
OTTAWA



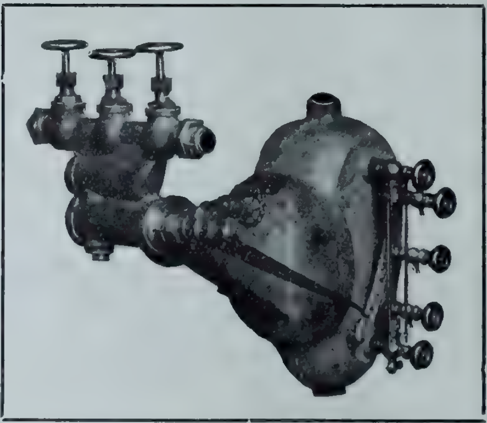
PUMP GOVERNOR
Patented April 19th, 1910

Engineers! Quit Worrying!

You can banish all your power plant troubles, and make your fireman look pleasant by using

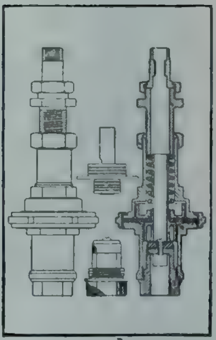
W. H. BICE'S STEAM APPLIANCES

Try BICE'S SPECIALTIES for thirty days free, which will keep water at given level, give dry steam, save fuel and chase away all troubles which the engineer is heir to.



FEED WATER REGULATOR. Patented Feb. 1st, '10

Write for Testimonials and Price List.



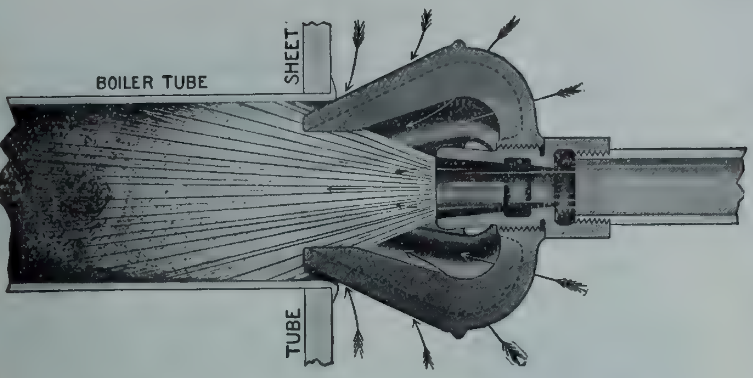
REDUCTION VALVE
for water, steam or air,
Patent applied for

MANUFACTURED BY

Automatic Feed and Regulator Company
100 Masonic Temple - - - LONDON, ONT.

The USE Of CLAFLIN'S

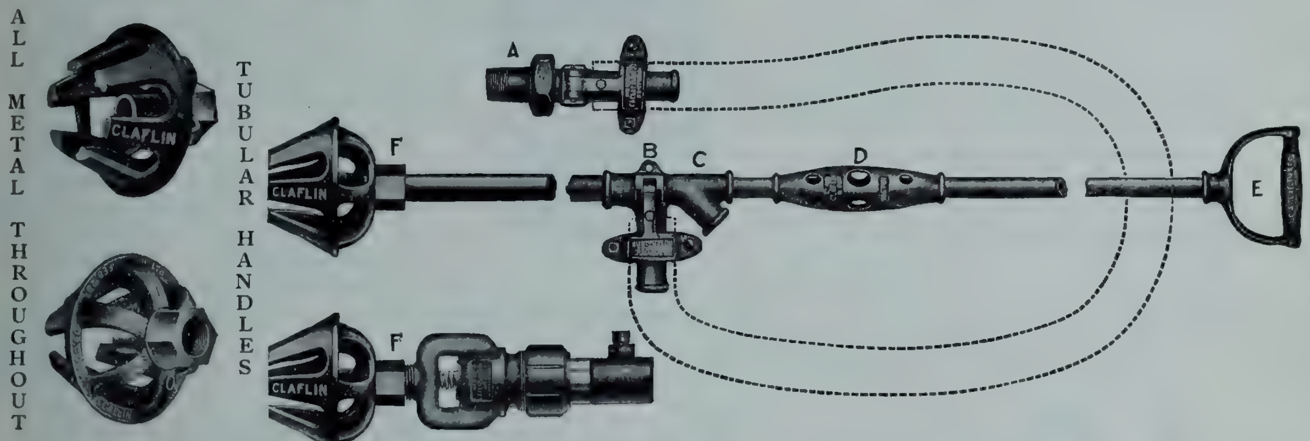
STEAM TUBE CLEANER . . Insures Increased Steaming Capacity



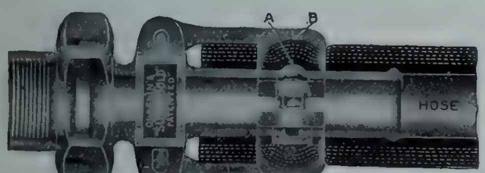
The most POWERFUL, RAPID and PRACTICAL apparatus ever devised for *Removing Soot* from boiler tubes.

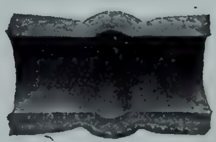
The divergent tapered Steam Nozzle (same as used in Steam Turbines) imparts a tremendous velocity to the steam jet which in turn induces an *enormous volume* of *air* through the Skeleton Head. This *dense, swiftly moving current* acts as a swab—*dislodging every particle of soot* in its path.

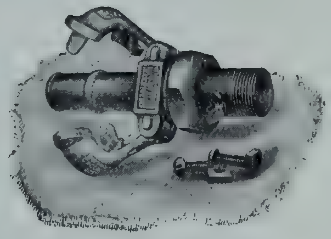
The addition of the "Telescope" Balanced Valve (shown below) causes the steam to automatically shut off when cleaner head is being moved from tube to tube. The handle can be transposed from a horizontal to an angular connection to reach high tubes.



"SURE-HOLD" HOSE FITTINGS . . . Put An End To Hose Blowing-Off







Unfailing SECURITY is INSURED by this REMARKABLY EFFECTUAL yet SIMPLE Device. Delays, Scalding-Accidents and Law Suits Eliminated by their Use.

NOTE—The Convex Rib "A" Bulges the Hose, and the Concave Recess "B" not only Straddles, but completely surrounds the Bulge—created by the Rib—thus producing an absolutely SURE-HOLD.

BRAIDED STEAM HOSE

Yields the longest service of any hose in existence. It's the braided feature, together with best materials and the "KNOW How," that enable this hose to "Give" like a basket and thus relieve the expansion due to heat of steam. That's the Secret that SAVES the LINING and makes "Staying Qualities" that are unequalled. Vulcan Hose is seamless, so cannot unwind. It is also the STRONGEST and MOST FLEXIBLE HOSE known. Other strong points are detailed in catalogue.

Claflin's Products are the acknowledged "Pace-makers" of their class. Don't waste your money and time with make-shifts, but TRY OUR GOODS a month at our risk. Return them at OUR EXPENSE, if they fail to make good.

SEND FOR NEW CATALOGUE AT ONCE—It's Interesting and Instructive.

CHAS. A. CLAFLIN & CO., Mfrs.
600 High St., Boston, U.S.A.

THE POWER ECONOMY CO., Agents
9 St. Nicholas St., Montreal, P.Q.

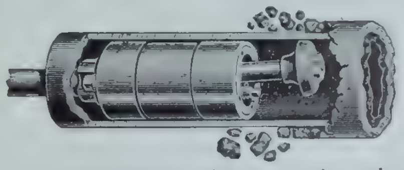
Saved $2 a Week on One Boiler

Doesn't seem much but multiply it by 52 and it's quite a bit. That's what one concern made by using

The Dean Boiler Tube Cleaner

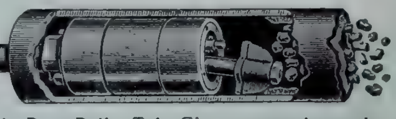
Where there are several boilers and the scale heavy the Dean has saved $150.00 to $1200.00 a year.
That's why we can afford to guarantee to every purchaser that the Dean will pay for itself in six months' use.
Why not try a Dean in one of your boilers and see how much you can save.

Write for booklet No. 130 and our free trial offer.



The Dean Boiler Tube Cleaner removing scale from the tube of a return tubular boiler.

THE WM. B. PIERCE CO.
330 Washington Street, Buffalo, N.Y.
Montreal Office : 230 Coristine Bldg., Montreal.



The Dean Boiler Tube Cleaner removing scale from the tube of a water tube boiler.

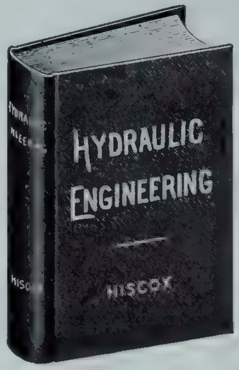
HYDRAULIC ENGINEERING

By G. D. HISCOX

Price $4.00 Postpaid
320 Pages. 305 Illustrations.

JUST OFF THE PRESS—this comprehensive book of Hydraulics written by an experienced engineer. It is a practical treatise on the properties, power and resources of water for all purposes, including the measurement of streams, the flow of water in pipes or conduits; the horse power of falling water; turbine and impact water wheels; wave motors, etc. All who are interested in Water Works Development should have a copy.

THE MACLEAN PUBLISHING CO., LIMITED
Technical Book Department 111-127 University Ave., Toronto



Keep in mind the dominant fact that mankind from its first appearance on the earth has been schooled by nature to look for signs; for invitations to taste; for suggestions as to what to wear. Tell your story briefly, forcibly, truthfully, and address it through the proper media and you can successfully apply advertising as a means to increased distribution.

A Chinese Family Doctor

so they say, is paid a salary to keep his patients well. When they get sick the salary is stopped until the patient recovers. Sensible scheme this; and confirms your suspicion that John Chinaman, for all his seeming childlike innocence, is a long-headed individual who knows very well on which side his bread is buttered.

"But what's this got to do with the price of Beef" say you. Well just this;---It points out the moral that prevention is away better than cure. If you allow great hunks of scale to coat the inside of your boiler tubes you are adding to the fuel bills and courting a boiler explosion. It's far better policy to begin right now and give your boiler the

Dearborn Individual Treatment

Dearborn Boiler Compound

is never kept in stock---every case is treated especially and only after an expert analysis of the feed water. Better draw off a gallon sample of your feed water to-day and express it to us for free analysis.

Dearborn Drug and Chemical Works
THE PIONEERS OF SCIENTIFIC WATER TREATMENT
Office, Laboratories and Works: - - - CHICAGO, U.S.A

Be Logical!

It's far more profitable to keep in health than to pay doctors' bills, and it's far easier and more profitable to *prevent* scale forming in your boiler by using the

International Boiler Compound

than to remove it after it has formed.

We make an individual analysis of each feedwater submitted to us free of all charge. Express us one gallon of the water you are using, and we will forward a *trial sample* of our compound guaranteed to remove *all* scale-forming elements.

This is a unique opportunity you should not fail to seize. It will mean the saving of much work, coal and trouble to you.

You can make money acting as our agent in your district. Write for details of our offer.

Get in touch with us to-day

International Boiler Compound
Company
144-146 West Michigan St., Chicago, Ill., U.S.A.

"Prevention is Better than Cure"

An old proverb which was never so true as when applied to the ***Scale Problem!***

Prevent the formation of Boiler Scale by treating your Feed Water with

POTATO SCALE BOILER CLEANSER

It will save fuel, keep your Boiler from foaming and is guaranteed not to injure tubes, shell or connections. Send me one gallon of your ***Feed Water*** and I will forward a compound which I will guarantee to free your Boiler from scale and to keep it free.

Sole Agent in America **C. C. SNOWDEN**

All letters to Calgary **Calgary, Alberta**

WORKS, DAUPHIN AND DELHI STS.

Don't Take Our Word For It!

ASK YOUR ENGINEER.

If he doesn't think your boiler feed water ought to be analyzed—we'll abide by his decision.

He is interested in your welfare, and his own, not ours.

Even if you have no scale there is danger of pitting and corrosion with a possible explosion liable to occur any moment.

A case of this kind in New England recently came to our notice: The engineer frequently warned the owner about the pitting and corrosion that was going on, but he only smiled, until the explosion blew the engineer and thirty other employes into eternity,—then—why of course he was sorry, but that did not pay his liabilities.

We offer to analyze your feed water or boiler scale FREE OF CHARGE.

If the water needs no treatment, we will tell you so frankly; if it does, we will prescribe a combination of

Lord's Water Purifying Chemicals

which we shall guarantee to remedy whatever trouble exists, but which you are in no way obligated to purchase.

We will take the risk of being able to demonstrate to your satisfaction that it will pay you to use it.

We have no ready-made boiler compounds. We treat water after analysis only. That is why we never fail.

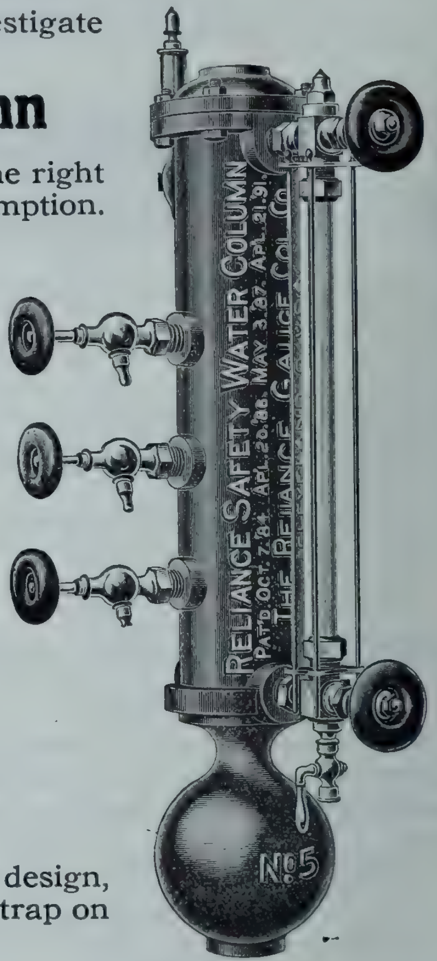
George W. Lord Company
PHILADELPHIA, PA.

Safety and Economy in your Boiler House

You owe it to yourself as a progressive engineer to investigate the

Reliance Safety Water Column

It enables you to keep your boiler feed water at exactly the right level for absolute safety and the utmost economy in fuel consumption.


RELIANCE SAFETY WATER COLUMN
PAT'D OCT. 7.84 APL.20.'86 MAY 3.'87 APL.21.'91
THE RELIANCE GAUGE COL. CO.
No 5

It is so constructed that whenever the water in the boiler to which it is attached falls below or rises above the right level a whistle shrieks an alarm. Thus the Reliance prevents the loss of power and waste of fuel caused by an over-abundance of water and prevents absolutely all danger of explosion from the effects of lower water. The valves of the Reliance cannot clog, as they are placed well above the high-water mark. Besides our combination high and low-water alarm, we also make a "Reliance" Column for low water alarm only. **Over 70,000 in use to-day.**

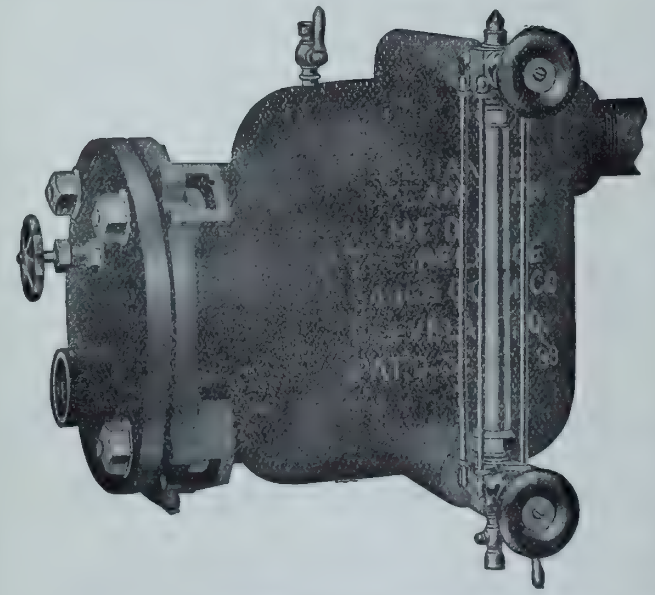
You may be "getting along somehow" without a "Reliance." But you would get along better with it.

Another one of our well-known specialties is the

Reliance Steam Trap

the Trap that NEVER FAILS

It is unlimited in capacity, simple and practical in design, and will give better and longer service than any other trap on the market.



The Reliance Steam Trap will handle every drop of condensation, whether it comes in floods or in driblets. The valve is controlled entirely by the inflow of the water with an action that is positive and never-failing, working equally well on high or low pressure systems. If you wish to draw out the trap or blow out the sediment, simply turn the hand wheel and the work is immediately accomplished. To inspect the trap, remove the four small nuts and the simple internal mechanism comes out with the tap.

Every Reliance "Steam Trap" is fully guaranteed---including the float.

Write to-day for our illustrated Catalog—Free.

The Reliance Gauge Column Co.

5902 Carnegie Avenue - - - Cleveland, Ohio

Will Your Boiler Develop its Full Rated Horse Power?

Exterior View

¶ The Wing Turbine Blower is a little, inexpensive machine that will make your boiler develop its full h.p. capacity, no matter if you burn the cheapest grade of fuel.

¶ In fact, there's no need to burn any but the cheaper grades of fuel where the Wing Turbine Blower is used.

Interior View

¶ This little machine—a perfect combination of Wing's Disc Fan with a simple and practical turbine engine—develops an extremely powerful draft. This draft mixed thoroughly with the small quantity of dry steam used in driving tne machine, passes under the grate and gives the most perfect combustion ever obtained by any mechanical or natural draft system.

¶ The use of the **WING TURBINE BLOWER** means increased Boiler Efficiency; the most Economical Consumption of fuel; a grate that is always free from clinkers; the elimination of tall, expensive chimneys.

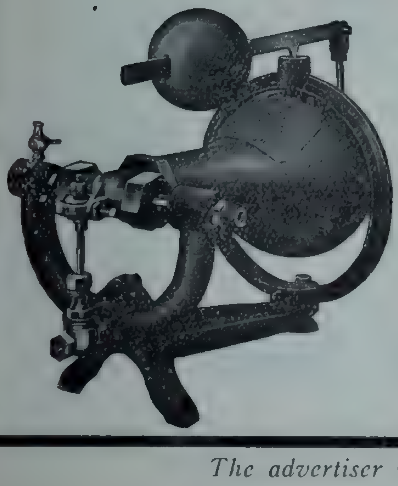
¶ *A Wing Turbine Blower installed in the boilers of the Harrison Baths at Toronto at once increased the power production of these boilers from 98 to 145 h.p. We can show you scores of similar cases.*

¶ We want to send every engineer in Canada a neat little pamphlet describing the Wing Turbine Blower. There is a copy waiting here for you. Write us a post card to-day and we'll mail you the pamphlet to-morrow.

RUSSELL & GIFFORD

404 McKinnon Building,
TORONTO

505 Power Building,
MONTREAL



Install a Bundy Steam Trap and Separator

—the one trap that never falls down on the job. A Bundy Trap has never been known to allow the escape of a single pound of condensation.

¶ Its record of unfailing efficiency and economy will recommend the Bundy Trap to every practical engineer.

¶ The Bundy Trap can be used successfully as a Boiler Feeder, the trap being placed three or more feet above the water line in the boiler and the feed-water temperature shall not be less than 100° F.

WRITE US FOR CATALOGUE.

The Reason Why

THE "BUNDY" STEAM TRAP

occupies its present unique position in the mechanical world is

Because The Results

achieved by its use, both in increased efficiency and decreased fuel bills,

Have not been attained through any other similar appliance

Every owner, superintendent and engineer in whose plant steam is used for heating, boiling or drying, is interested in learning what we can do to decrease operating cost and to increase output.

We are effecting direct fuel economies of from 15% to 50% in some of the largest industrial establishments in Canada. No plant is too large and none too small to have the full benefit of our experience.

We are Specialists in condensation and we show results.

Catalogues and detailed information are available on request

PEILER & MACKENZIE, - 52 St. James Street MONTREAL

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Sales Agents for

"BUNDY" Steam Traps and Separators

Of Equal Interest to Manager and Engineer

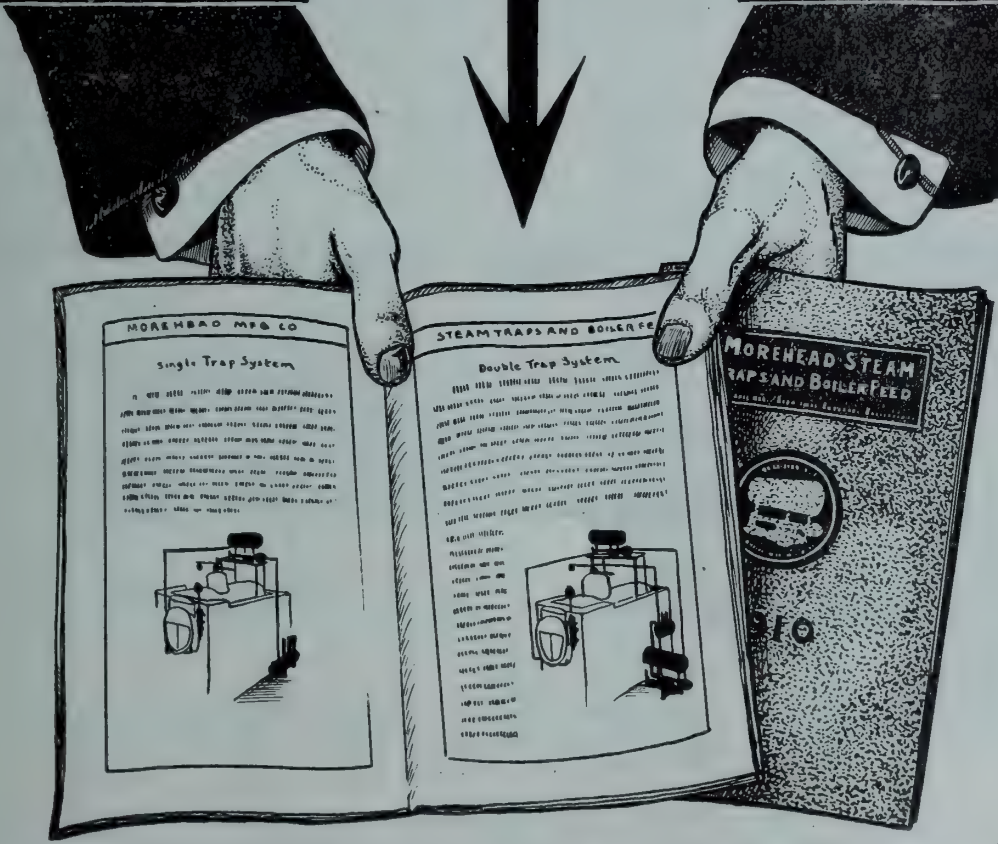
TO THE MANAGER

The "Trap Book" points the way to better steam plant and heating conditions—to cutting down fuel expenses—to better management.

TO THE ENGINEER

The "Trap Book" describes and illustrates a method of bringing about a more harmonious working of the steam plant—to the credit and comfort of the engineer.

Clip the slip for your copy and send it to-day.


MOREHEAD MFG CO
Single Trap System
STEAM TRAPS AND BOILER FE
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MOREHEAD STEAM TRAPS AND BOILER FEED
1910

Morehead Mfg. Co.

Dept. "J" **DETROIT, MICH.**

CANADIAN REPRESENTATIVES: A. R. Williams Machinery Co., Toronto; W. H. Markle, Montreal; Park Bros., Chatham, Ontario.

MOREHEAD MANUFACTURING CO.
Dept "J" Detroit, Mich.
Gentlemen: Please send me copy of "Trap Book" and your trial offer proposition.
Name.............................
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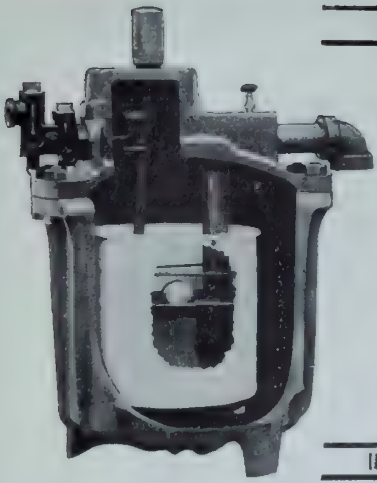
Firm Name.............................

The advertiser would like to know where you saw his advertisement—tell him.

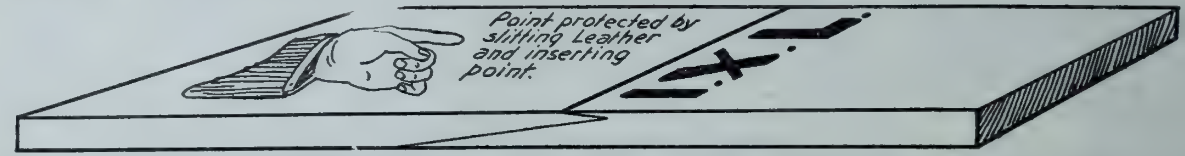


THE ALBANY
STEAM TRAP

Will solve the problem for you. Backed by over 40 years' trap experience. Get in touch with the makers:---

The Albany Steam Trap Co.
ALBANY, N.Y.

THE "I.X.L." SPLICE "THE BELTING SPLICE THAT WILL NEVER COME OPEN"



The great trouble with *any* belting—no matter how good the leather—that is joined up with the ordinary splice, is the fact that the splices come open, causing loss and delay. J. D. McArthur's Leather Belting made with the " I.X.L." SPLICE, as shown in this cut, *cannot* come open at the splices. Note the protected point, outside point running same direction as pulley.

J. D. McArthur's Leather Belting is made from Prime British Oak-Tanned Leather, from Close-Trimmed Backs exclusively.

Write for our complete price list. J. D. McARTHUR & CO., Brockville, Ontario

Stock at Toronto Branch 639 King St. East; J. E. Stephenson & Co., Agents

Approaching the Ideal!

THE
Duffy Steam Trap

is nearer the ideal sought after by engineers than any other trap on the market. Its distinctive and controlling feature lies in the expansion and contraction of iron pipe in coil, as shown in cut. It possesses large draining capacity, and will drain system when steam is shut off, thus preventing danger from frost. May we prove our claims? We will send a DUFFY TRAP to any responsible party on

30 DAYS' FREE TRIAL. ***Write for one to-day.***

FRANCIS DUFFY, 136 Stuart Street, KINGSTON, ONT.

THE FLINN STEAM TRAP

A Differential Trap

With Only Three Moving Parts

There are no buckets, no floats, no joints to pack, **and** there is no trouble.

It is a trap that can be recommended for almost any and every class of work, because it is the only steam trap on the market that embodies such simplicity with such a wide range of possible adaptions.

It will work equally well at any pressure from 1 to 300 pounds and **in any position** over 45 degrees. Vibration of buildings or the tossing of vessels has no effect upon it.

Besides its inherent advantages, every trap is sold under a positive guarantee which is a safeguard to the buyer.

Write for further particulars.

Richard J. Flinn

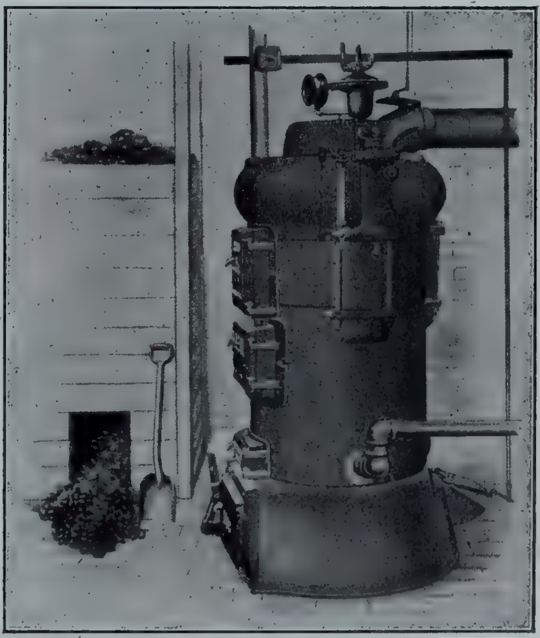
WEST ROXBURY - MASS.

CANADIAN AGENTS:

THE POWER ECONOMY CO. - Montreal

WEBSTER "QR" MODULATION SYSTEM OF STEAM HEATING

The convenient position of the Modulation Valve enables the occupant of each apartment to regulate the temperature at will.



The ordinary cast iron boiler, as used with the Q.R. Modulation System, is automatically controlled by our Webster Damper Regulator.

This system is applicable to any medium size type of Buildings, Hotels, Apartment Houses, Private Residences, Office Buildings, Churches, etc.

Write for Catalogue "QR"

DARLING BROS., Limited :: Montreal

WINNIPEG ST. JOHN, N.B. TORONTO

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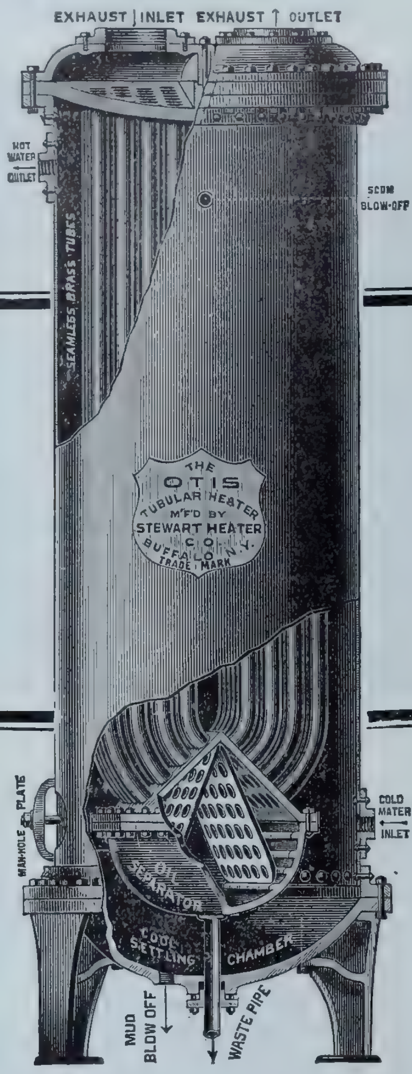
TUBULAR FEED WATER HEATER, OIL SEPARATOR AND PURIFIER.

Tried and Trusted

Not an Experiment



CATALOGS AND PRICES

YOURS ON REQUEST

You have our

Unconditional Guarantee

that the "OTIS" will heat the Feed Water to the boiling point with the exhaust steam, without causing any back pressure. It will also extract the oil from the exhaust, so that the exhaust steam after being passed through the heater can be used for other heating purposes. It will return the water of condensation from the heating system to the boiler without the additional expense of an eliminator.

We also guarantee by the use of our Purifying System, to remove all old scale from the Boiler Tubes and to prevent the formation of any new scale.

We agree to pay ALL COSTS of a trial if the OTIS fails to do all we claim for it.

THE Stewart Heater Company

189 Norfolk Avenue, Buffalo, N.Y.

External View

The Feed Water Heater

that is guaranteed to heat water to the highest temperature possible.

The Heater whose efficiency remains constant from month to month and from year to year.

The Heater that has the greatest amount of effective heating surface per rated horse power.

The Heater that by constant agitation of water, which is spread out in thin sheets instead of circulating through tubes or coils of pipe, secures the greatest economy to be had.

The Heater that does not clog up, scale or get out of order and is as nearly indestructible and without need of attention as anything of the kind can be made.

Send for prices and description of the Transverse-Current Heater, the design of which will at once appeal to your practical good sense.

The Williams Tool Co.

ERIE, Pa.

Successors to Riblet Heater Co

Also Heaters for Gas Engines.

General Agents for Canada:
The Standard Engineering Co., Limited
47 Wellington St. East, Toronto

Internal View.
Heater with Circulating Plates removed.

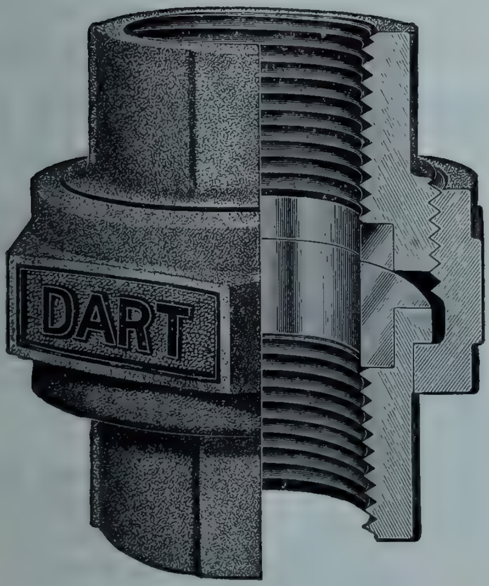
Dart Unions Make Cheerful Engineers

If every engineer realized the time, trouble and money saved by using Dart Unions, pretty nearly all other methods of pipe connection would become obsolete.

No packing whatever is required with Dart Unions.

Both sections of Dart Unions are seated with smoothly-ground, rustless, enduring bronze.

They come together in the form of a ball-joint that is easy to make and absolutely steam, air, oil and water tight.



¶ This cut shows the screwed Dart Union with a section cut out showing the construction. Did you ever see anything mechanical so simple and well designed?

¶ Note particularly the construction of the smooth-ground bronze seats, absolutely non-corroding, and which eliminate all need of packing. Note the weight of fitting and the long, full threads.

¶ You will be amazed at the speed with which even the most difficult joints can be successfully made with Dart Unions.

¶ Dart Flange Unions for larger sizes of pipe made on the same principle.

Dart Unions will not leak. They stay tight until you loosen them deliberately.

Ask your Dealer for and insist on getting Dart Unions

DART UNION COMPANY, Limited

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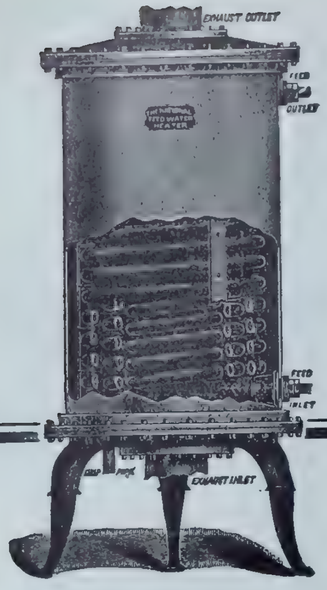


There can be no back pressure with the

National
Feed Water Heater

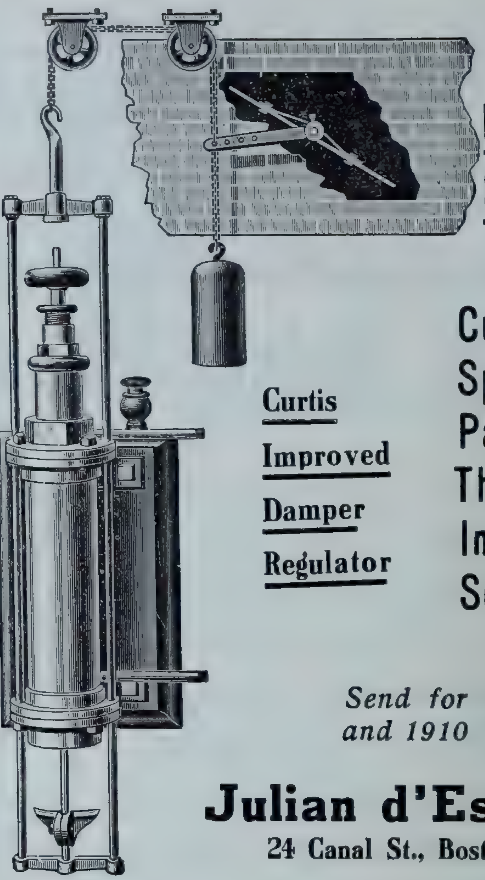
because its shell area is six times that of its exhaust pipe.

Unlike other heaters, it permits no contact of water with the shell, has no inside joints or straight tubes, and rarely costs anything for repairs.

From 1 to 14 coils of Seamless drawn brass or copper tubing are encased in a cast iron or steel shell to which exhaust steam is admitted, heating the water passing through the tubing.

We have a booklet on *Feed Water Heating*, which is yours for the asking. Send for it to-day.

THE NATIONAL PIPE BENDING COMPANY
91 LLOYD STREET
NEW HAVEN : : CONN., U.S.A.



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Curtis Improved Damper Regulator

Curtis Specialties Pay For Themselves In Good Service.

Send for Circular and 1910 Catalog.

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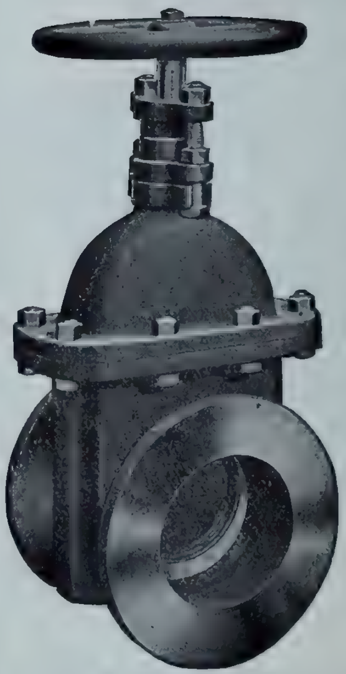


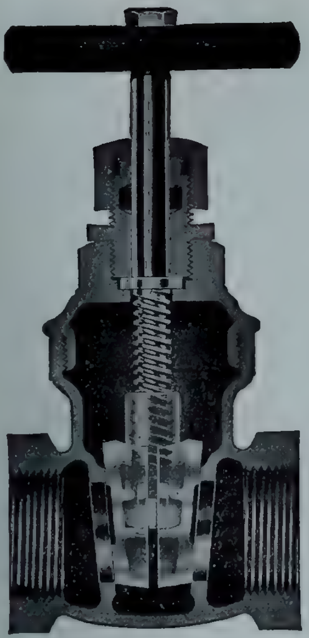
KERR GATE VALVES

are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

Write for our Catalog of High Grade Brass and Iron Valves.

The Kerr Engine Co., Limited
Valve Manufacturers
Walkerville, - Ontario



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Jenkins Bros.'
Gate Valves
TYPE "K"

¶ This valve is one of our latest productions. The design is along lines which give the best distribution of metal and greatest strength.

¶ The gate consists of double compensating bronze wedges which are prevented by guides from coming into contact with the valve seat until completely closed. This gate *cannot jam* in the valve body because the first movement of the spindle loosens the discs and the guides remove them from the seat faces.

¶ Every part is machined to gauge and is absolutely interchangeable. Each valve is individually tested before leaving the factory and is *fully guaranteed.* Why not buy the valves that you can *depend on?* Each valve bears our Trade Mark.

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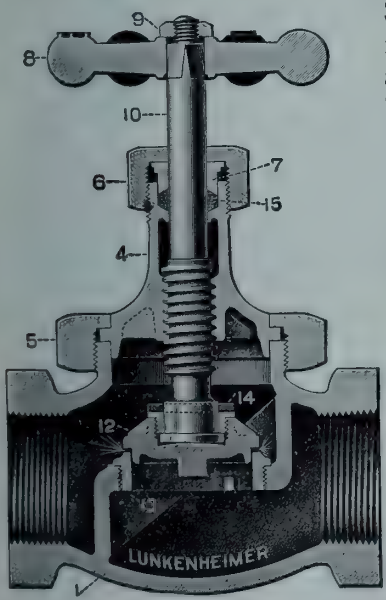
LUNKENHEIMER "RENEWO" VALVES

ARE POSITIVELY THE MOST DURABLE AND PRACTICAL MADE

THE SEATING SURFACES CAN BE REGROUND and ALL PARTS SUBJECTED TO WEAR CAN BE RENEWED; including the DISC and SEAT. The SEAT is SELF-CLEANSING and is made of a hard, close-grained nickel. The bronze used contains a high percentage of copper and tin. The improved construction of the disc PRESERVES THE SEATING FACES and PREVENTS WATER HAMMER.



LUNKENHEIMER "RENEWO" GLOBE, ANGLE and CROSS VALVES are guaranteed for 200 pounds working pressure, and are made in sizes ranging from ¼ to 3 inches, inclusive.

"Most supply houses sell them—yours CAN—if they DONT or WONT, tell US.
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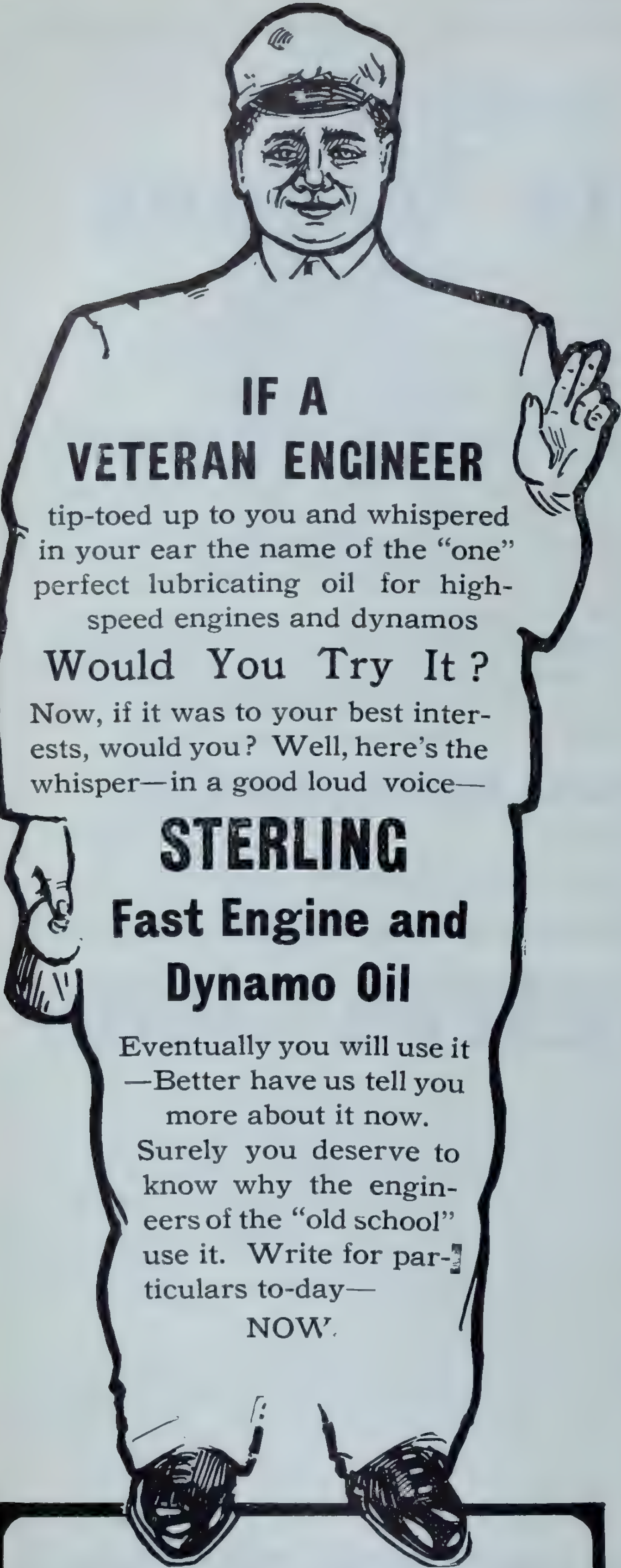

IF A VETERAN ENGINEER

tip-toed up to you and whispered in your ear the name of the "one" perfect lubricating oil for high-speed engines and dynamos

Would You Try It?

Now, if it was to your best interests, would you? Well, here's the whisper—in a good loud voice—

STERLING

Fast Engine and Dynamo Oil

Eventually you will use it—Better have us tell you more about it now. Surely you deserve to know why the engineers of the "old school" use it. Write for particulars to-day—NOW.

Canadian Oil Companies LIMITED
TORONTO

St. John, Montreal, Ottawa, Hamilton, London,
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A Polished, Slippery Pulley is a Sure Sign of Power Lost

Every slipping belt is burning leather, is decreasing the output of its machine, is racking machinery and doing jerky, uneven work. Every belt that has been tightened to prevent slipping is being stretched to death, is wearing out babbitt in machine and shaft bearings. And every tight or slippery belt is relentlessly eating up *your* profits in the coal bin. You can stop the waste just as well as many progressive concerns all over the country, who have made the test and who are now using

WARREN'S PULLEY COVER

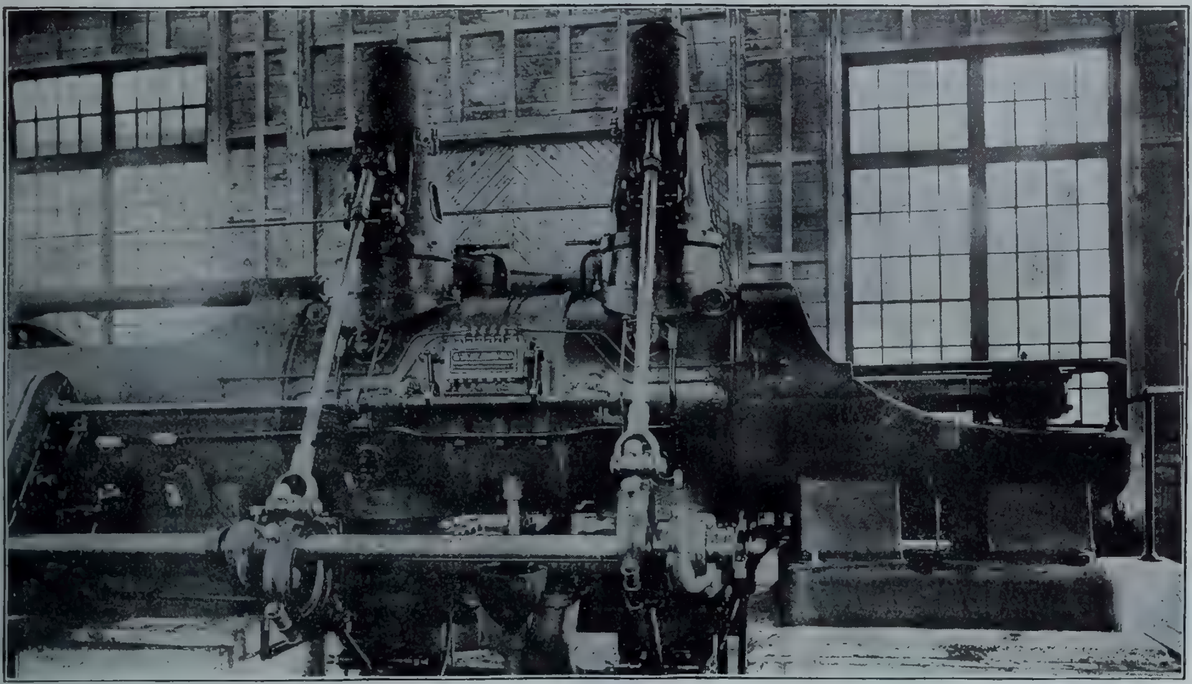
It is applied with a brush as easily as ordinary paint and dries in from two to four hours. You can do the work at night when the machinery is idle and begin to cut down expenses the next day. One application will last from one to three years. It gives a firm leathery surface for the belt to grip—eliminates the impractical extravagance of leather lagging, the sticky, unreliability of "belt dopes"—prevents the loss in your plant from slippery polished pulleys.

MAKE THE TEST NOW

that will save you money as long as you run a pulley in your factory. Send an order to-day for $5.00 trial can, sufficient to cover 40 square feet of pulley surface—brushes and full instructions for application included. The test is so easily, so inexpensively made that you cannot afford to deprive yourself of its big advantages. Make an investment that will be returned in one week's time. Don't delay the saving one day. Instruct your purchasing agent to order the trial can NOW.

The Garlock
Packing Company
Sole agents for Canada
HAMILTON - ONTARIO

GAS ENGINE CYLINDER LUBRICATION



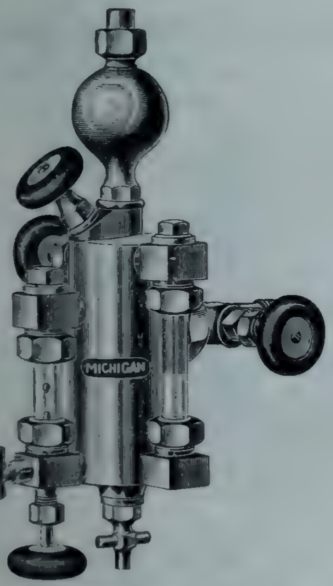
For double acting gas engine service the special model M. pumps have proven efficient and economical. We have had several years of success in this field and our engineering department will take pleasure in going over this proposition with you. Over 1300 cylinder feeds of this kind in one plant. Bulletin 209 L. describes this model fully.

Manufactured by the **SIGHT FEED OIL PUMP CO.,** **MILWAUKEE, WIS.**

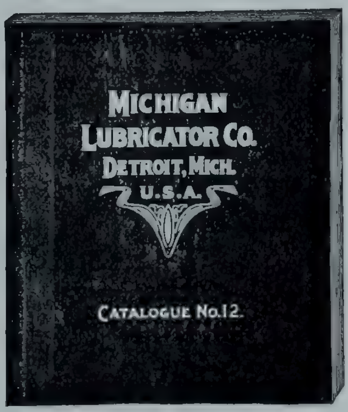
PLEASE CONSULT OUR CANADIAN REPRESENTATIVES, MESSRS. WILLIAMS & WILSON, MONTREAL, CANADA.

MICHIGAN

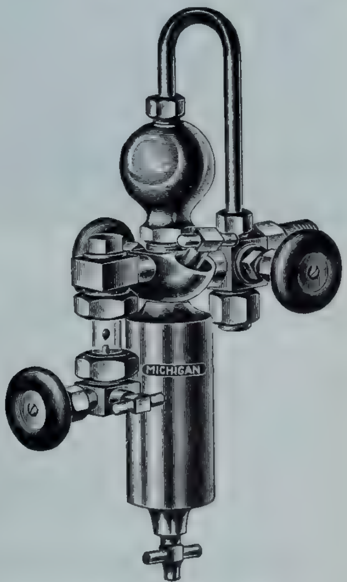
Illustrated catalog mailed to you free



Improved Double Connection,



WRITE TO-DAY



Improved Single Connection.

MICHIGAN LUBRICATOR CO.

DETROIT, MICH.

This is the name to
remember when in the market for belts

"CLIMAX"
LEATHER
BELTING

Tanned and Manufactured by

Sadler & Haworth
ESTABLISHED · 1876

MONTREAL
Toronto, Winnipeg, Vancouver
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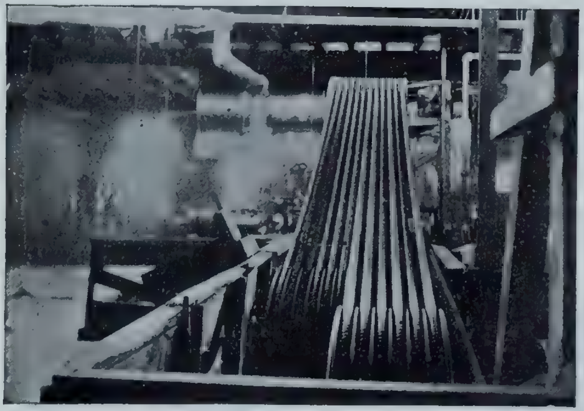

CLING-SURFACE IS GOOD FOR ROPES, TOO.

Cling-Surface penetrates the rope to the very core and surrounds each fibre with a preserving lubricant. Not only does Cling-Surface fill up the uneven outside surfaces to make the cable smooth, round and capable of the most efficient pulley contact, but it renders every part of the rope pliable and impervious to moisture.

The absence of chafing of the inner fibres in a rope treated with Cling-Surface materially increases the life of the rope. Slip is prevented with less weight on the tightener, and this alone is a relief to engine and drive, which makes Cling-Surface more than pay for itself in power saved.

Write for literature.

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SOLE MANUFACTURERS OF THE CELEBRATED

"MAPLE LEAF" BRAND
Stitched Cotton Duck Belting

FOR TRANSMISSION OF POWER, CARRYING, ETC
THE TRUEST RUNNING

TH STRONGEST

THE MOST ECONOMICAL BELT

MADE IN CANADA

As a Main Drive Belt "Maple Leaf" cannot be excelled. Write for prices.

"MAPLE LEAF" BELT DRESSING is the best on the market for all kinds of belts.

THERE'S never any belting trouble in the plant where they use the old reliable D. K. McLaren's Genuine British Oak Tanned Leather Belting.

It is the one make of leather belting that can be relied upon absolutely to transmit every h.p. that your engine develops.

Engineers who use D. K. McLaren Belting say that it works so well that they hardly ever realize that they are using belting at all. And it certainly does give the longest service of any make on the market.

For all general purposes we recommend

EXTRA "C" and "D. K. BALATA"

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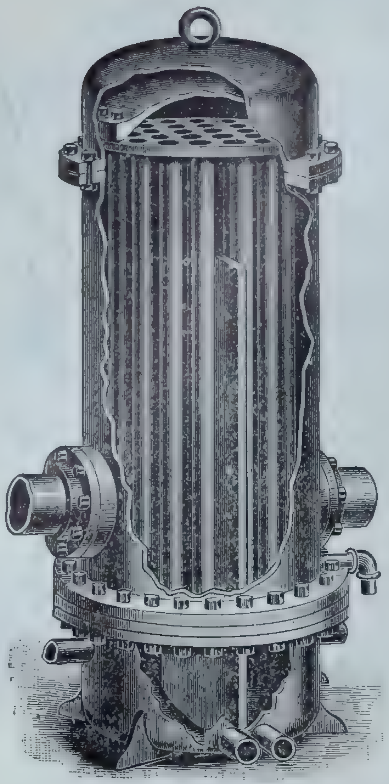

The Jacobs Feed Water Heater

Combines in itself all the qualities of a simple, effective and well constructed apparatus built on thoroughly mechanical lines

It is constructed of cast iron—fully machined at every joint. The tubes are drawn brass and are arranged to allow for expansion—the top header being free to move - see cut. This simple heater will outlast your boilers and will not bother you with heater troubles.

IT IS FULLY GUARANTEED

Chas. J. Jacobs & Co.

42 OLIVER STREET **Boston, Mass.**

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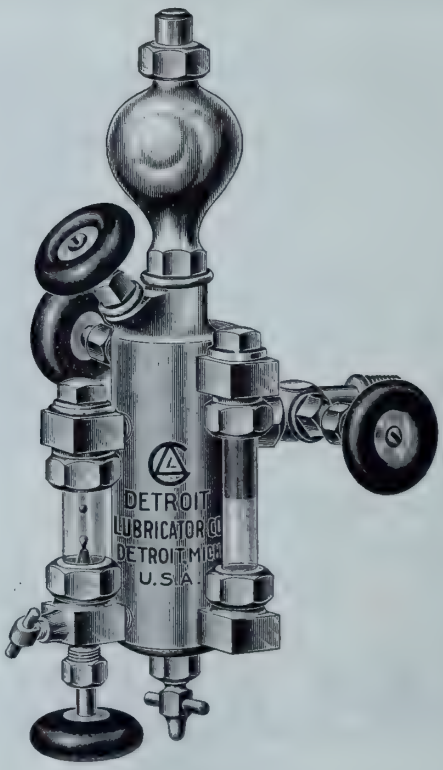
Send for Catalog A58 Illustrating 339 Types-Sizes



Simple in theory.

All that skill and money can produce in construction.

Dependable in practice.

Every "Detroit" Lubricator is carefully inspected before shipping.

The first "Sight Feed" Lubricator was originated by the Detroit Lubricator Co. over thirty years ago.

To-day we operate the largest plant devoted to the manufacture of Lubricating Devices in the World.

Be sure you get the Genuine "Detroit".

DETROIT LUBRICATOR COMPANY.

DETROIT, U.S.A.

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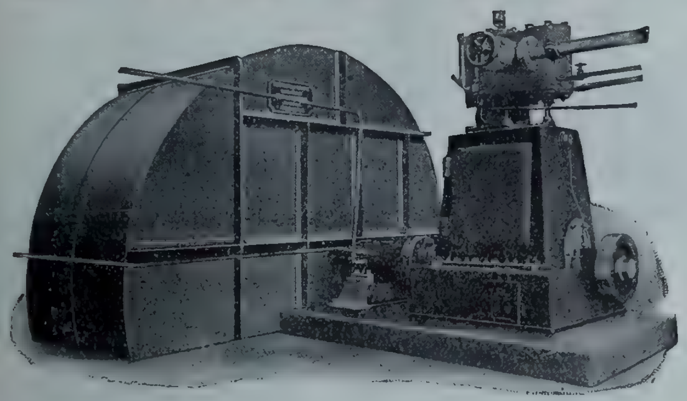

STEEL PLATE CENTRIFUGAL TYPE are extensively used for **INDUCED DRAUGHT** because they Save Coal, Increase Steam and Stop Smoke.

Also for **REFUSE** and **DUST COLLECTION** from Wood Working Machinery.

And **PLENUM VENTILATION** with **HEATING** for Works and Public Buildings of all kinds.

OPEN PROPELLER TYPE

Belt, Electric or Steam Driven, are still unrivalled for **General Ventilation**, because of their

SIMPLICITY, EFFICIENCY and RELIABILITY.

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and thousands of others.
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Prices Low
Workmanship
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Ask for Catalogue No. 100.

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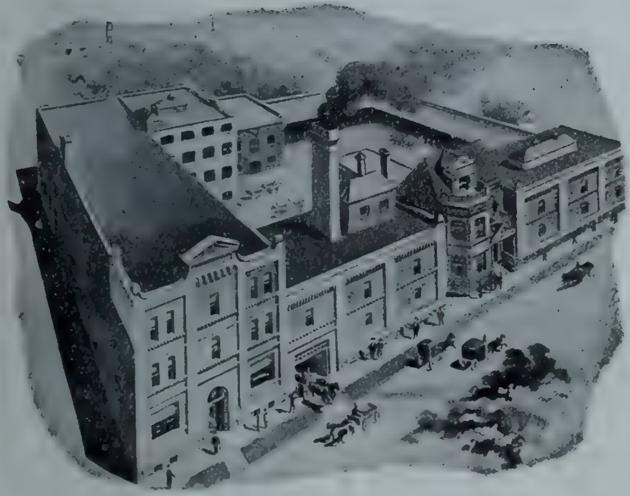
TORONTO
Manufacturers of



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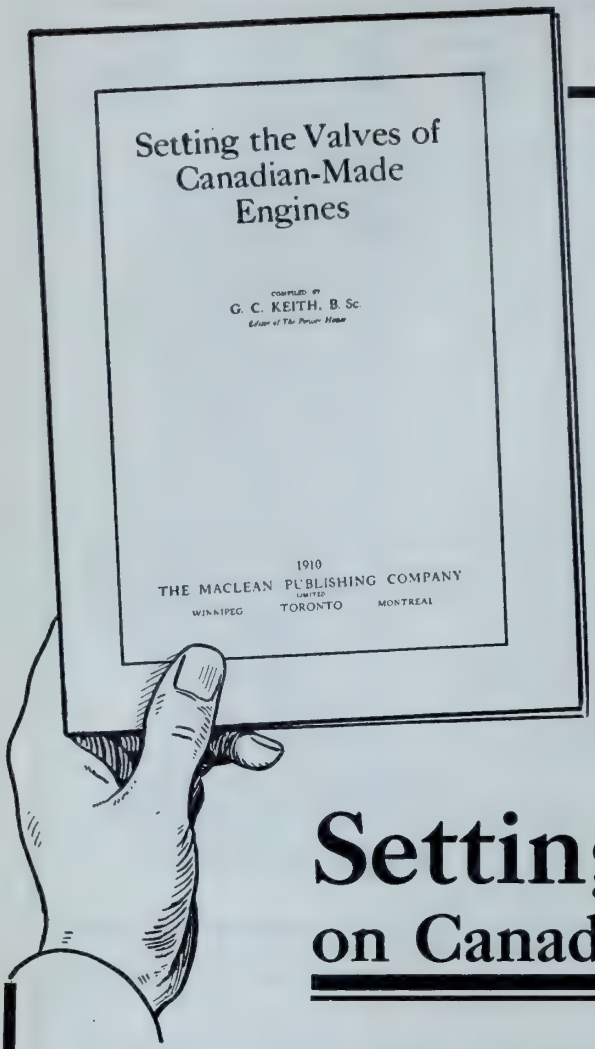

Setting the Valves of
Canadian-Made
Engines

COMPILED BY
G. C. KEITH, B. Sc.

1910
THE MACLEAN PUBLISHING COMPANY
WINNIPEG TORONTO MONTREAL

SEND US 50c.

for a copy of this useful Book

This is a book that every up-to-date engineer should possess. It contains reprints of a series of valuable articles that appeared during the past year in "The Power House," on

Setting of Valves
on Canadian-made Engines

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Robb-Armstrong Corliss Engine; Waterous Corliss Engine; Goldie & McCulloch Wheelock; Goldie & McCulloch High Speed; Brown Automatic, made by the Stratford Mill Building Co.; E. Leonard & Sons Corliss.

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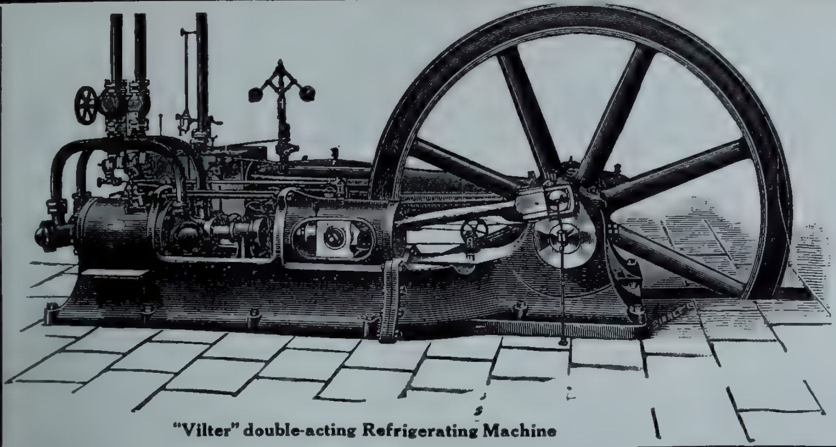

"Vilter" double-acting Refrigerating Machine

Established 1867

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BUILDERS OF HIGH-GRADE

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ICE AND RFRIGERATING MACHINERY

any size and for any purpose, complete line Ammonia Fittings, Condensers, Brine Coolers, etc.

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Send for our catalogue showing details of installations and containing many useful tables and other data concerning this industry.

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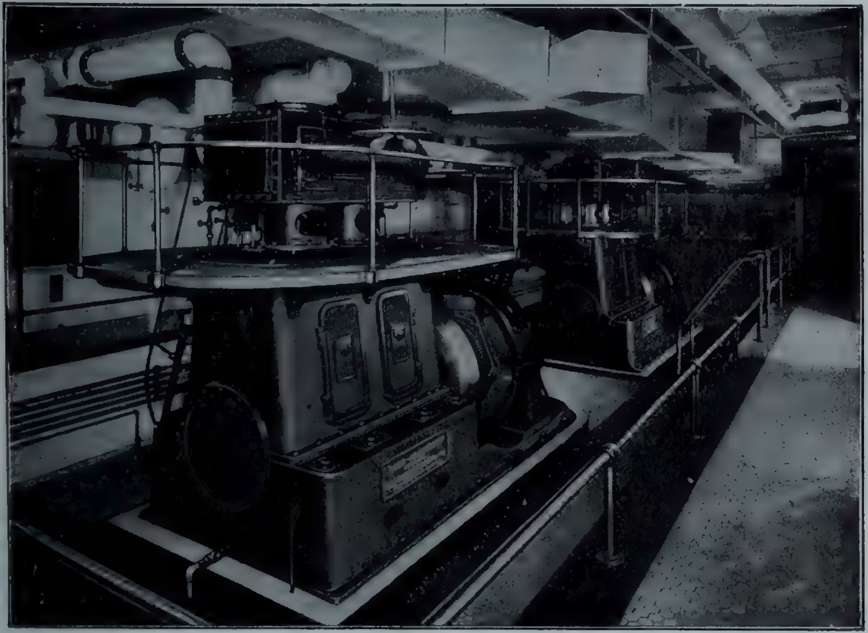

Has Cost Nothing

for Repairs

A customer says:—

"We have used one of your vertical high speed engines, English type, forced lubrication, since 1907. The engine runs at 425 revolutions per minute almost constantly night and day. It has given us every satisfaction and so far has cost us nothing for repairs."

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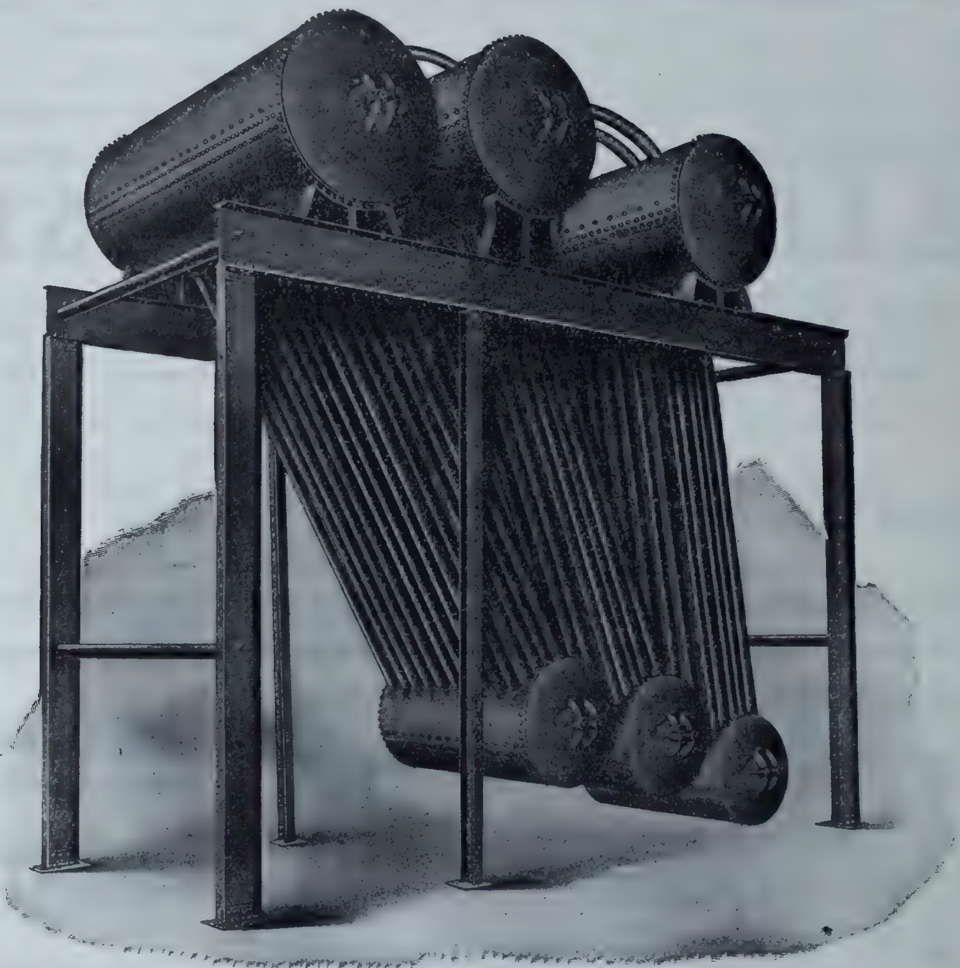
Return Tubular, Horizontal Marine, Vertical and Portable Boilers, with or without Wheels



Side View of our NEW WATER TUBE BOILER. Not bricked in.

Our Engines, Boilers, Heaters, Pumps and Condensers are Prominent in Canada's Largest Power Houses.

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STAYING FIRE BOX OF A LOCOMOTIVE TYPE BOILER

J. C. Douglas Wilkes B.Sc.

IN stationary engineering the problems of the locomotive boiler are rarely encountered, nevertheless it will no doubt be of interest to study the most persistent of these problems—staying the fire-box.

This problem is accentuated by the constant breaking of the ordinary rigid stay-bolt, and the equally disturbing but less frequent cracking of the fire sheets. These occurrences have long been the bugbear of master mechanics of railroads all over the world, and have been the cause of earnest attention being paid to overcoming this particular branch of fire-box maintenance.

In stationary boilers of the ordinary tubular type the disturbing occurrence of leaky stays, broken stays and cracked fire sheets is almost entirely absent. This is because the heat is more evenly maintained and distributed and boilers of this type are so constructed as to have no two plates in close proximity to one another, and stayed to each other, one of which is heated to a greater degree of temperature than its neighbor and, as a consequence, expands considerably more. It will be seen later that this difference in expansion in fireboxes of locomotive boilers is very appreciable.

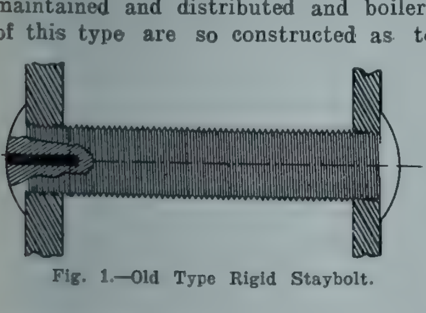

Fig. 1.—Old Type Rigid Staybolt.

In locomotive fire-boxes, the fire sheets are subjected to an intense heat which is also variable, while the outside sheets, to which the fire sheets are stayed, are subject only to that heat corresponding to the steam pressure which is a comparatively constant temperature.

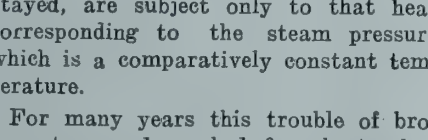

Fig. 2.—Hollow Staybolt Iron.

For many years this trouble of broken stays and cracked fire sheets has met with but little resistance beyond that afforded by expert workmanship and highly improved material. That some attempt to avoid it by staybolt design occurred is shown in the manner in which the staybolts shown in the accompaning cuts were made. Fig. 1 shows the old type rigid staybolt which is simply a piece of staybolt iron threaded its whole length, screwed through the outer plate, across the water space and into the fire sheet, and riveted over on both ends. The telltale hole shown in the end was thought to be advisable as it permitted inspectors to detect fracture by the emission of water or steam. A still later innovation was the hollow staybolt iron as shown in Fig. 2. These improvements were good as far as they went. They do not prevent the breakage, but they make detection of broken stays easier except where bad water is experienced. This usually clogs the holes when the stay breaks, making detection by observation of steam emission impossible.

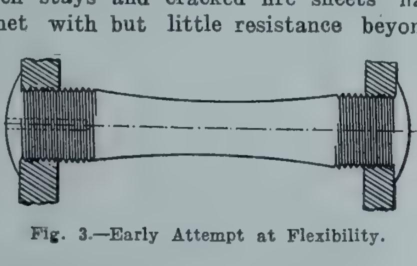

Fig. 3.—Early Attempt at Flexibility.

That flexibility in the staybolt was also recognized as being essential to insurance against breakage is shown by the staybolts in Figs. 3 and 4. These show rigid staybolts that have been turned down in the centre to make them more flexible.

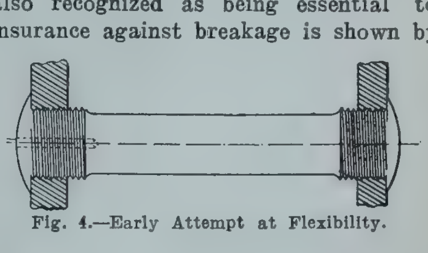

Fig. 4.—Early Attempt at Flexibility.

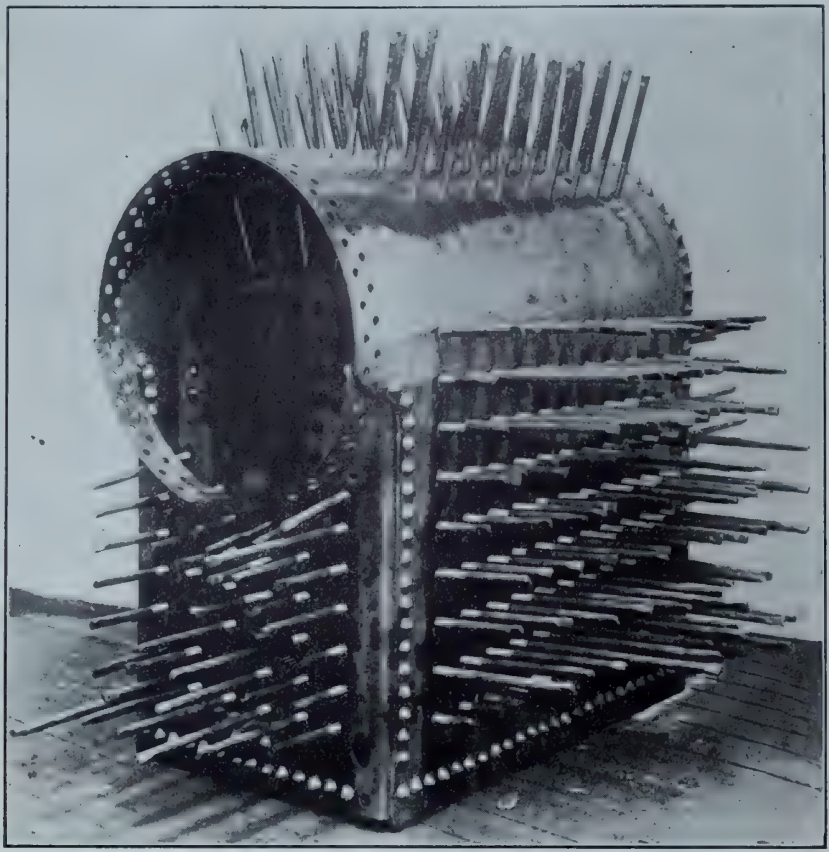

Fig. 5.—Rigid Staybolts Just After their Installation and Before Shearing off and Riveting.

Fig. 5 shows the method generally followed when installing the rigid type of screwed stays. This illustration shows the firebox end of a small traction engine boiler, which, although not as large as that on a "Mogul" is subject to similar strains. The stays are threaded in long bars, screwed in the proper distance, clipped off and riveted over.

The logical improvement to the stays illustrated in Figs. 3 and 4 was the stay that would give to the uneven expansions and at the same time undergo no bending strain which would ultimately break down the fibres and cause fracture. Naturally these took the form of a jointed stay and in such the boiler making world has its "flexible" stay.

Before describing the methods of applying and the different types of these stays it will be interesting to study what sort of stresses and strains occur in a locomotive boiler to cause so much trouble and necessitate the design of flexible stays.

Attention has been called to the different heats to which the fire-box end of the boilers are subjected. This causes unequal expansion to take place and it is this unequal expansion and the resisted expansion that causes all the trouble.

To find the amount of this expansion the mean temperature of the plates exposed must be known. To arrive at this temperature the condition of the plates on the water side must be determined and how much water per square unit of surface is evaporated per hour. Many tests have been made to determine the evaporative power of locomotive boilers and from these it is comparatively easy to find approximately how much a boiler of given dimensions can evaporate. Having this it is only necessary to ascertain what percentage of this evaporation is due to the tubes and what is due to the fire box.

The curve in Fig. 6 is based on the results of careful tests of evaporation. It gives, in percentages, the evaporation and the heating surface so that if the percentage, due to the fire box, of the boiler's total heating surface be known the corresponding percentage of evaporation for the same can be read off. By following the curve, it will be seen how quickly the ratio of evaporation due to the flues diminishes towards the smoke box. Take, for example, the first and last 10 per cent. of the heating surface. The first evaporates 38 per cent. of the total, whereas the last only 3 per cent. From this curve can be determined the evaporation of each square unit of heating surface of the fire-box and of each square unit of tube surface.

From the curve shown in Fig. 7* the temperature of the plates is found from the evaporation. The curve A repre-

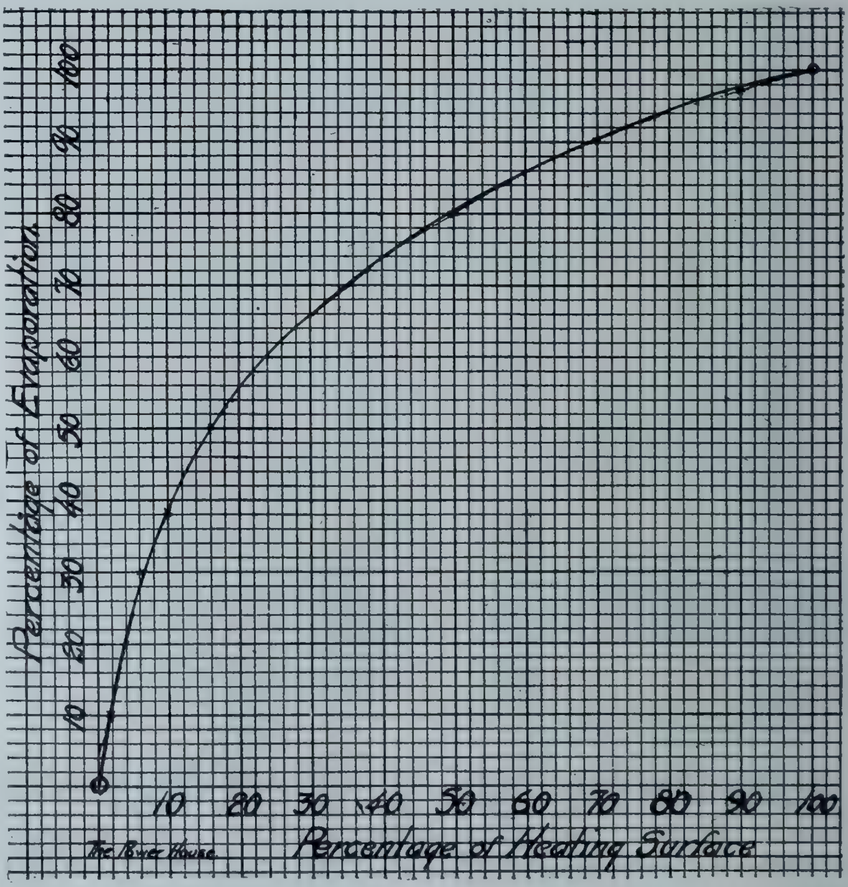

Fig. 6.—Percentage Curve.

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* See "Annales du Conservatoire des Arts et Metiers," Paris, 1889.

sents the results obtained from clean plates and distilled water; curve B, from plates with a scale deposit of 1 mm. (.039 inch) thickness; curve C, from plates with a scale deposit of 5 mm. (.195 inch) thickness. Curve D is the mean between B and C and represents, more approximately, working conditions. The experiments from which these curves were plotted were conducted with the valves open and the boiler at atmospheric pressure. The temperature would then be 100 degrees Centigrade and, therefore, to more approach working conditions, the steam temperature less 100 degrees, must be added to the plate temperature.

Take, for example, an evaporation of 220 kilograms per square metre (45.06 pounds per square foot) at 12 atmospheres (176.4 pounds per square inch) steam pressure, temperature of steam 190 degrees C., the plate temperature would be:

With clean plates, 204 deg.+(190—100) =294 deg.

With 1 mm. scale, 245 deg.+90 deg.= 335 deg.

With 3 mm. scale, 300 deg.+90 deg.= 390 deg.

With 5 mm. scale, 450 deg.+90 deg.= 540 deg.

From the temperatures found the expansion of the tubes and fire-box sheets can be computed. In doing so the co-efficient of expansion for steel has been taken at

$$\frac{1}{850} \text{ for each 100 degrees C.}$$

For purposes of demonstration take a locomotive boiler which evaporates 7,000 kilograms (15,435 pounds) of water per hour at a pressure of 12 atmospheres (176.4 pounds) and having a total heating surface of 119 sq. m. (1,281 sq. ft.) the fire-box containing 97 square feet, or 7½ per cent., and the tubes 1,184 square feet or 92½ per cent.

Referring now to Fig. 6, the fire-box with its 7½ per cent. evaporates 32 per cent. of the 7,000 kilograms or 249 kilograms per square meter (51 pounds per sq. ft.) while the tubes evaporate 68 per cent. or 4,760 kilograms (8.81 pounds per sq. ft.)

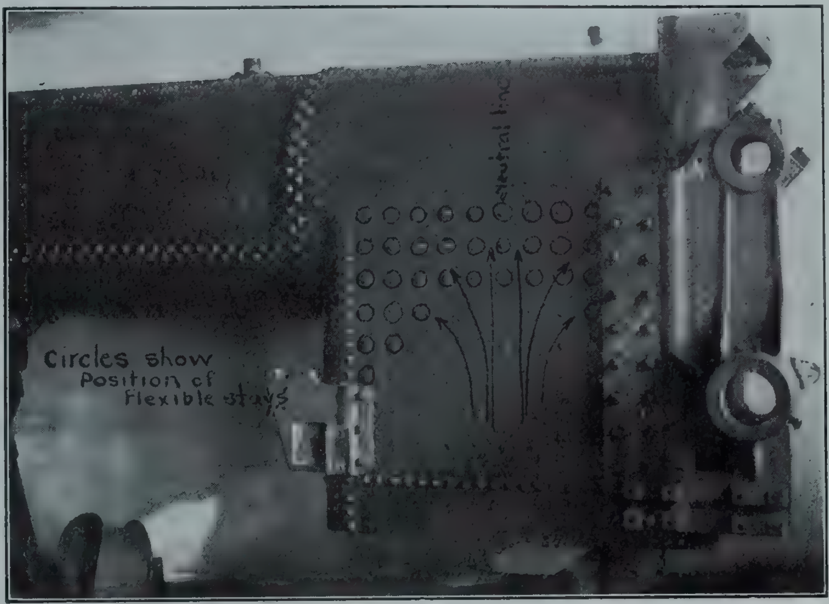


Fig. 8.—Probable Direction of Movement of the Molecules of the Plate in Expanding.

From Fig. 7 the mean temperature of the firebox is found to be 333 deg. + 90 deg.=423 deg., and for the tubes 183 deg. + 90 deg. =273 deg. This would give an expansion for the various parts, as follows:—

	mm.	Ins.
Staybolts	0.22	0.009
Fire-box	16.36	0.638
Tubes	15.52	0.605

The formula used in figuring these is:

$$\text{Elongation} = \frac{1}{850} \times \text{length} \times \frac{\text{temperature}}{100}.$$

The expansion of the outer shell, taking the length as 6.211 metres would amount to 13 mm. Therefore, the expansion of the inner parts of the boiler is 18 mm. more than that of the outer taking the sum of the expansions of the inner parts as found above. The expansion of the stay-bolts has been neglected because this amount is so small as to pass out of the calculations. This difference, 18 mm., equals 0.73 or nearly ¾ inch, and is therefore of great importance.

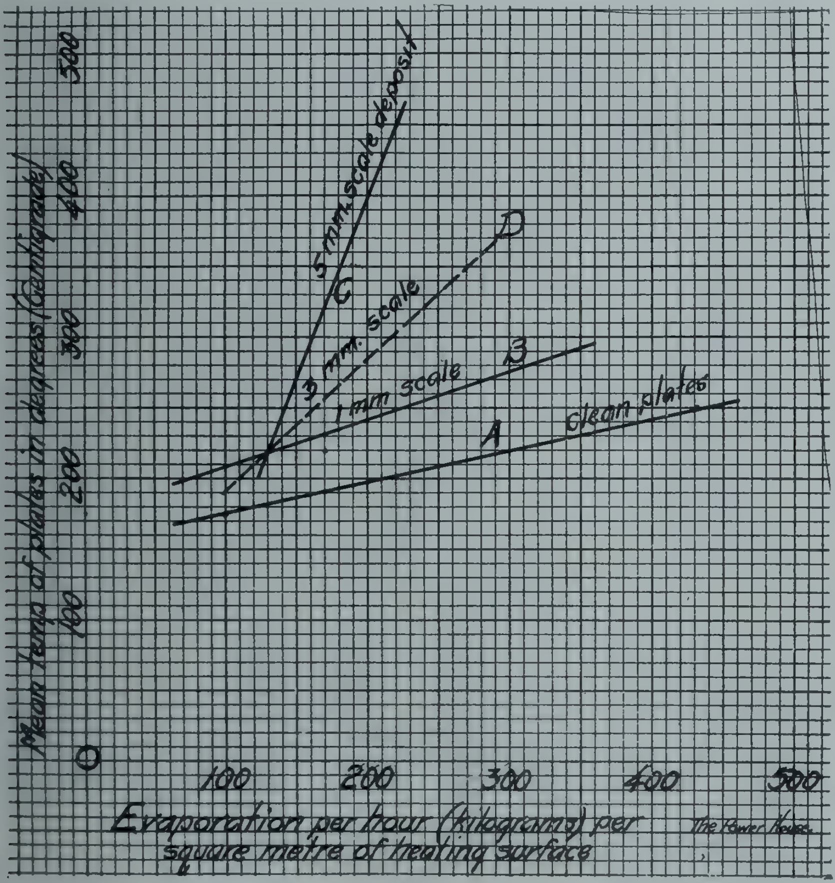


Fig. 7.—Temperature—Evaporation Curves.

In the walls of the fire-box this expansion takes place from the mud ring, upwards and outwards, and as the portions of the plate close to the ring are actually cold or very cool the expansions at this point are negligible. In Fig. 8 the arrows show the probable direction of the motion of the molecules of the sheets when expanding; upwards from the mud ring where the plates are anchored, and outwards from the central or neutral portions. The amount of elongation of the inside sheet gradually increases its lead over that of the outside sheet until the maximum difference is reached at the outside rows.

It is obvious that as the plates are continually heated and cooled these stay-bolts will be subjected to a vibratory motion and if they are of the rigid type, made of iron of a close, short fibrous structure, dense and hard, with a correspondingly very high tensile strength, the plates would eventually crack or bulge. On the other hand the stays, if not strong enough to cause the plate to go, will be given the same strain that is used to break a piece of wire when no cutting pliers are at hand, with exactly the same result—the fibres become fatigued and eventually break.

It is not difficult to figure the prabable amount of this vibratory movement. In the boiler described above the fire-box is 1.45 m. high. The sheets here would be subjected to at least 450 degrees C., and, if much scale has accumulated, to as high as 500 degrees. The expansion, worked out as before, would amount to 11.25 mm. or 0.44 inches, whereas the outer sheets, at a temperature of only 294 degrees, that of the steam, would only expand 3.08 mm., a difference of 8.17 mm., or 0.32 inch.

On a short stay which is hardly ever more than from 4 to 6 inches between plates this difference stands for a considerable pendulic motion which can only be absorbed without fracture by a stay designed to give and take—a flexible stay.

This transverse force due to the unequal expansions of the inner and outer sheets has been usually overlooked in determining the factor of safety under which the water space stays are used. As this factor is the proportion of ultimate strength over and above that strain encountered during working conditions, no force should be overlooked which would have any effect on it.

The theoretical deflection of the bolt for any load is:

$$D \text{ equals } \frac{W\,L3}{3\,E\,I} \text{ (equals .32 in this case)}$$

where

W equals load on the bolt.

L equals length of bolt.

E equals co-efficient of elasticity, which is about 30,000,000 pounds for wrought iron.

I equals moment of inertia of the section of the bolt.

The fibre stress on a bolt under these conditions is:

$$Sf \text{ equals } \frac{3XDXEXe}{l2}$$

where

Sf equals fibre stress.

D equals deflection.

E equals co-efficient of elasticity.

e equals distance of outer fibres from the centre of bolt.

l equals length of bolt.

If the bolt were four inches long and .892 inch diameter at bottom of thread (1 inch stay) the stress would be:

$$S \text{ equals } \frac{3X\ .32X\ 30{,}000{,}000\ X\ .4459}{4X4} \text{ equals } 802{,}620 \text{ lbs.}$$

This amount is extremely high and away above the limit but gives a striking example of the terrific strains that are encountered by the fire-box material A deflection of only $\frac{1}{8}$ inch would give a stress of over 300,000 pounds, and as this deflection is not extraordinary it is extremely important that the bolt be flexible and only called upon to carry a straight tensile strain.

Flexible stay-bolts of various designs are now being used by many railroads and the general results obtained are very satisfactory. These results depend upon the distribution of the bolt over a given area and to the service of each particular instalation. These instalations are generally made to cover what is known as the breaking zone of the rigid stay. This, in the majority of cases, extends below the crown sheet line from 3 to 5 horizontal rows across the fire sheet and diagonally downwards on the front and back end of the side sheet, see Fig. 8. Several railroads have recently made a practice of making every bolt in the water space area flexible, with the exception of the crown stays.

When it is considered that the present fire box has not been designed particularly for flexible stay-bolts, they have effected a remarkable service showing in comparison with the rigid type. This points to the fact that the flexible type should be used on all locomotive fire-boxes in part or on the whole, not only to provide mechanical means of allowing for expansion, but because this type eliminates to a very high degree the liability of accident due to broken stays and cracked fire sheets.

Photos by courtesy of Waterous Engine Works, Ltd., Brantford.

Other cuts by courtesy of the Flannery Bolt Co., Pittsburg. Curves by the author.

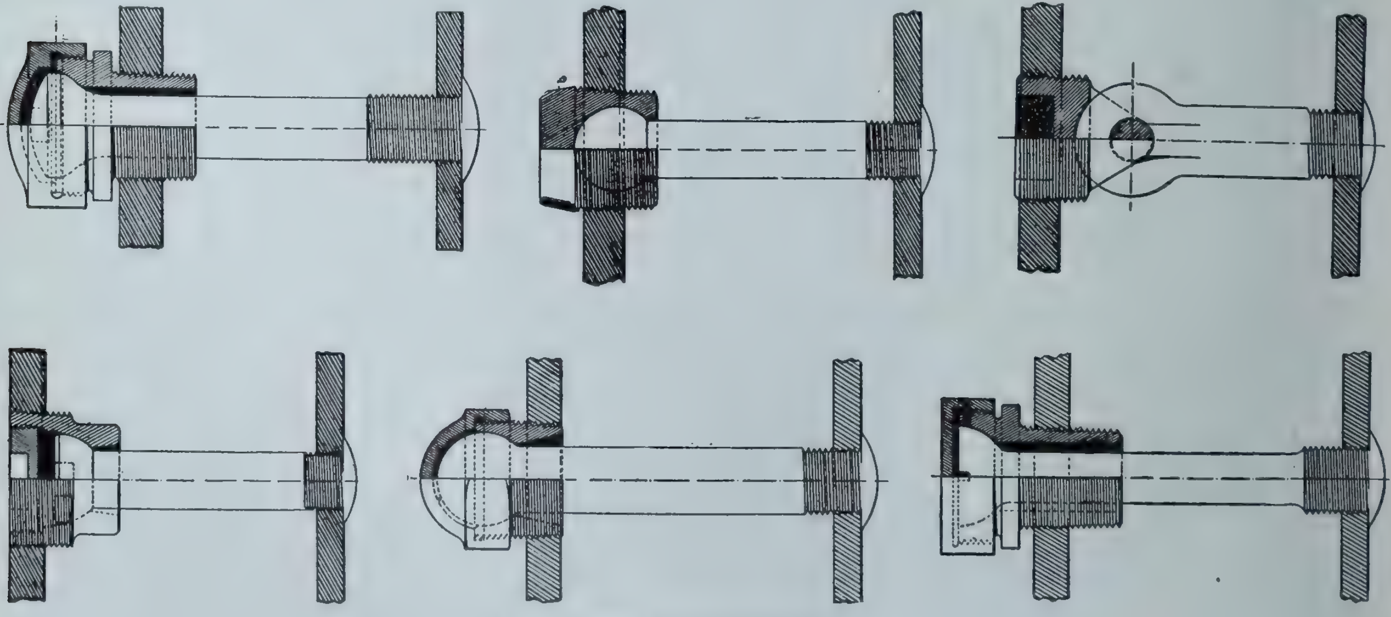


Fig. 9.—Types of Flexible Staybolts.

Specific Heat of Superheated Steam

By FRED. H. MOODY, B.A.Sc.

Superheated steam is saturated steam that has been heated to a higher temperature than that corresponding to the boiling point; hence its name superheated, i.e., over-heated.

As no thermodynamic investigation can be carried out unless the heat contents of the fluid at hand be known, its specific heat is of very great importance, for it is this as basis that all calculations relative to heat contents are made.

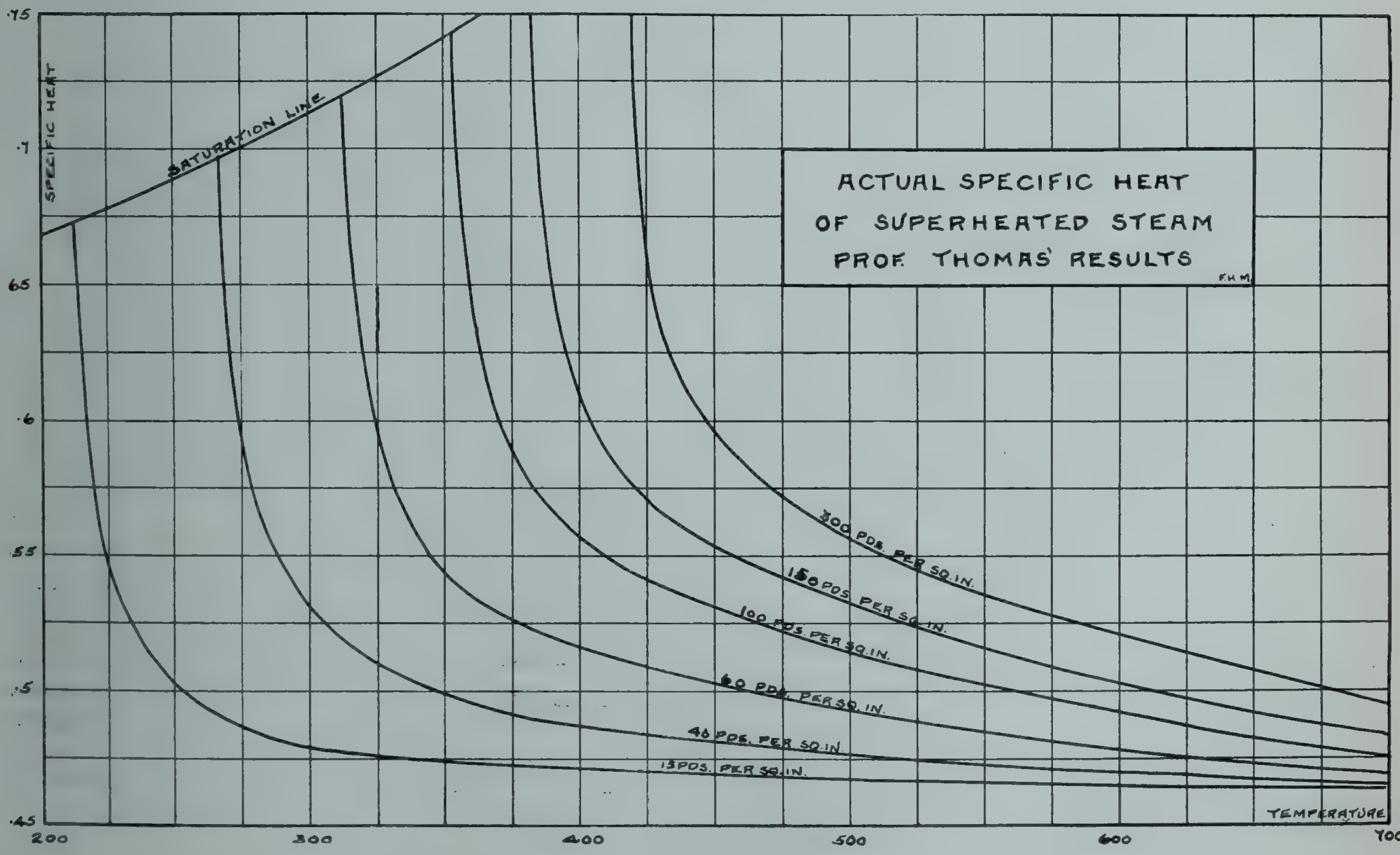
The specific heat of superheated steam may be considered in two ways—under constant pressure or under constant volume, that is, the amount of heat required to raise a unit weight of steam one degree under constant pressure or the amount of heat required to raise a unit weight one degree under constant volume respectively. Now, as there are no constant volume processes in a steam engine, but rather constant pressure ones, such as the generation of the steam in the boiler and superheater, the specific heat at constant pressure will alone be touched upon. It is well that little necessity arises for the specific heat of superheated steam at contant volume, for practically no data has been evolved dealing with it. A great deal of investigation has been carried on with the specific heat at constant pressure by prominent experimenters, but even it is still in a very uncertain state, as this article will show. It is usually denoted by the symbol Cp.

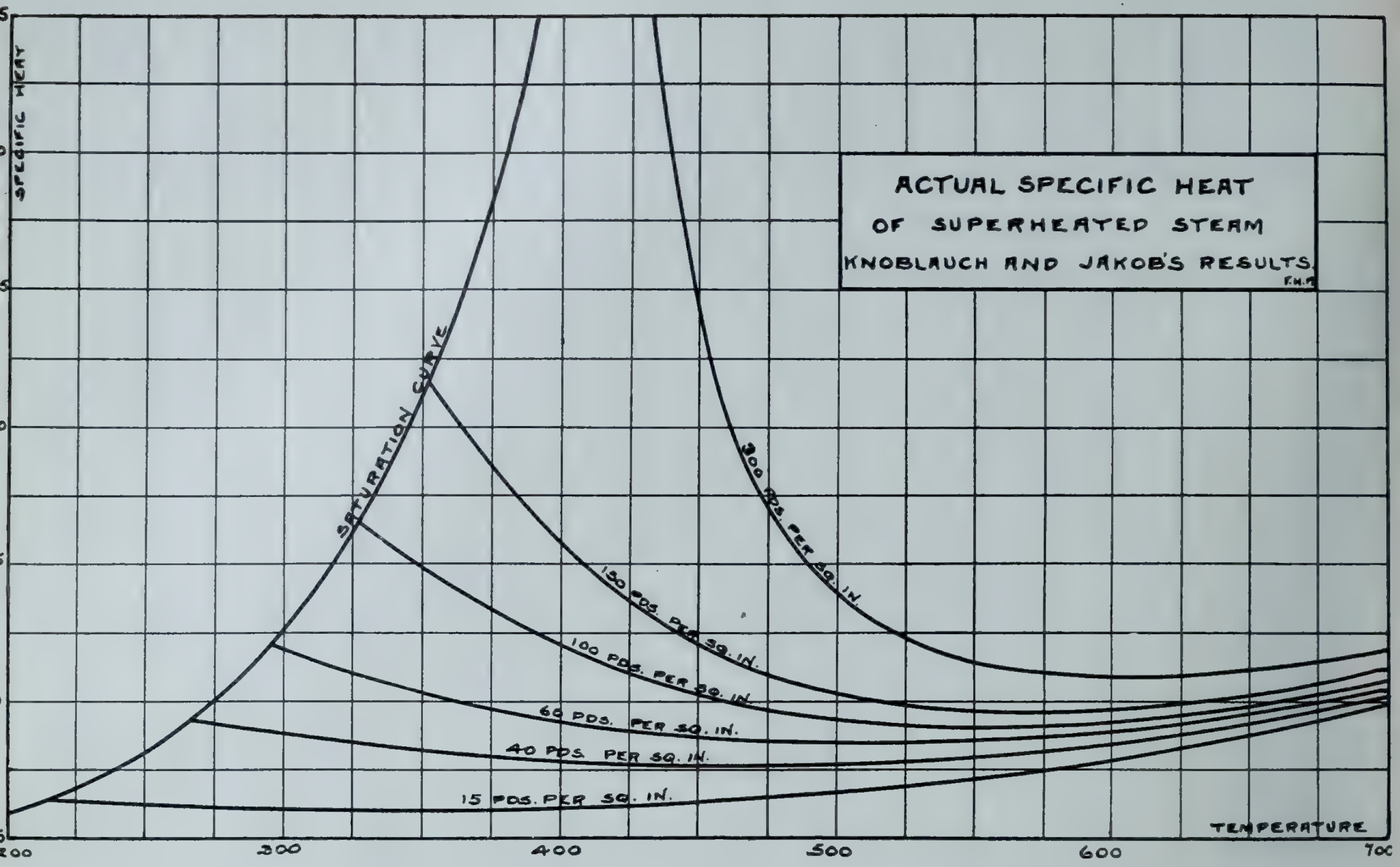
As with saturated steam, Regnault, in 1862, was about the first investigator to determine the thermodynamic quantities of superheated steam. From the mean of three experiments made by him, he discovered that Cp was constant for both temperature and pressure and was .4805 in value. Zeuner, in later experiments corroborated this value.

Herr Strahl in his investigation took Zeuner's value of Cp=.48 for low temperatures about 300 deg. F. and thereabouts, and a value of Cp=.60, with which he credits Bach, for high temperatures, around 600 deg. F., taking a mean value of .54 for intermediate temperatures. He thus assumes that Cp varies with the temperature, increasing with it, but that it is constant at all pressures.

Investigators, too numerous to mention, claim that Cp varies in different ways—increasing and decreasing with temperature, also increasing and decreasing with the pressure, and in some cases that it is constant throughout. Most cases combine different conditions for different temperatures and pressures, i.e., that Cp increases with temperature and decreases with pressures, etc., although nearly all authorities, up to the last couple of years, were agreed on the constant value of .48.

In 1905-6-7 two separate investigations were made, both with extreme care. One of these was by Profs. Knoblauch and Jakob, in Germany, while the other was by Prof. Thomas, then of Cornell University. While as just mentioned, extreme care was exercised, there is somewhat of a variation in the results obtained from the two experiments. The results of both experiments at different




ACTUAL SPECIFIC HEAT
OF SUPERHEATED STEAM
KNOBLAUCH AND JAKOB'S RESULTS.
F.H.M.
SPECIFIC HEAT
·75
·70
·65
·60
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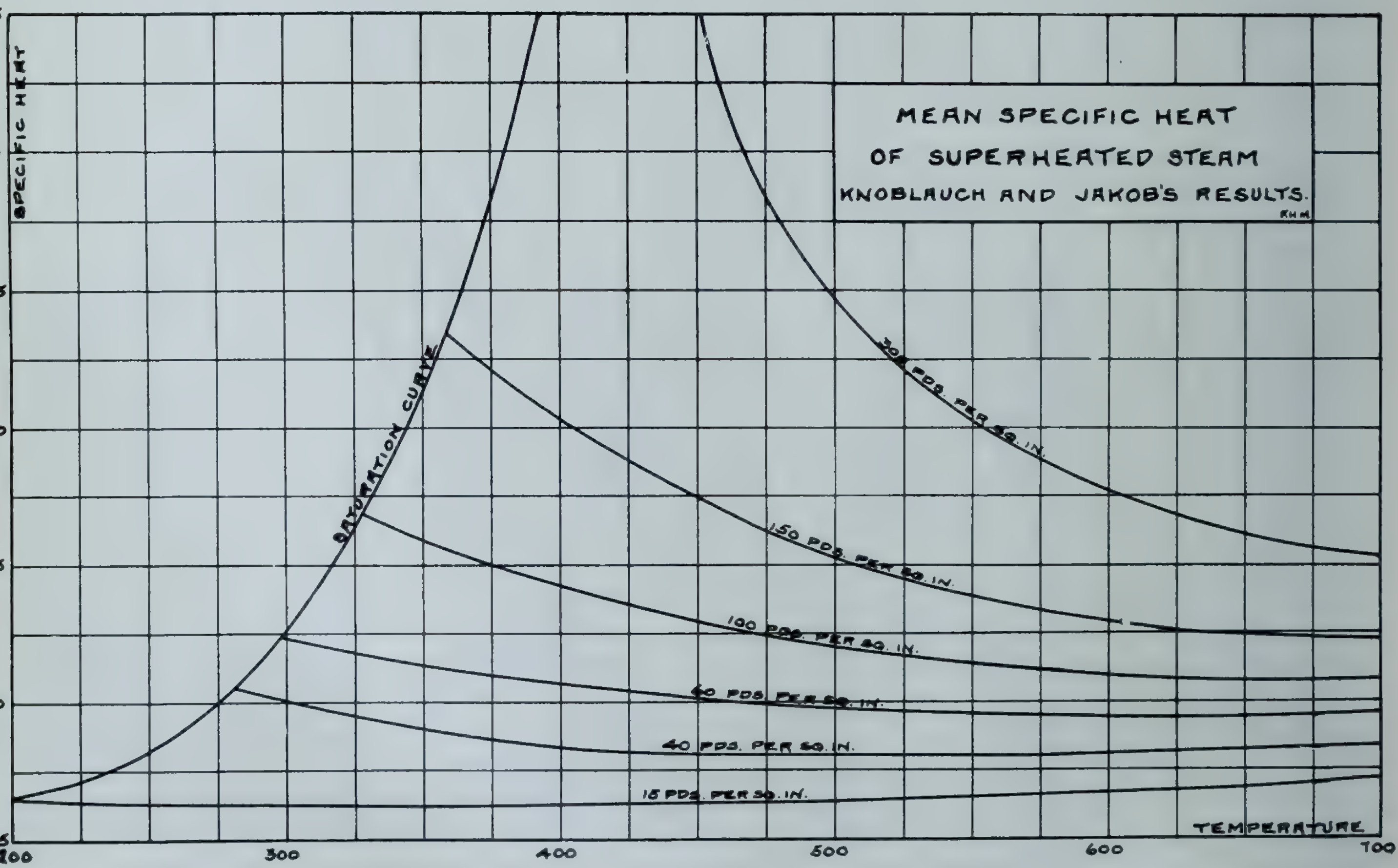
·50
·45
200
300
400
500
600
700
TEMPERATURE
SATURATION CURVE
300 PDS. PER SQ. IN.
150 PDS. PER SQ. IN.
100 PDS. PER SQ. IN.
60 PDS. PER SQ. IN.
40 PDS. PER SQ. IN.
15 PDS. PER SQ. IN.


MEAN SPECIFIC HEAT
OF SUPERHEATED STEAM
KNOBLAUCH AND JAKOB'S RESULTS.
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SPECIFIC HEAT
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TEMPERATURE
SATURATION CURVE
300 PDS. PER SQ. IN.
150 PDS. PER SQ. IN.
100 PDS. PER SQ. IN.
60 PDS. PER SQ. IN.
40 PDS. PER SQ. IN.
15 PDS. PER SQ. IN.

pressures and temperatures are given on the accompanying curves.

Cp may mean two things, (a) the specific heat at a point , i.e., the amount of heat required to raise a unit weight of superheated steam one degree, at the particular pressure and temperature that the Cp corresponds to, or (b) it may imply the mean specific heat, i.e., the amount of heat required to raise dry steam from the saturation temperature to the particular temperature to which we are superheating, divided by the number of degrees of superheat. (a) and (b) differ considerably, particularly at intermediate and somewhat high superheats, as shown by the curves.

In most engineering problems, the specific heat at a point is of little value—the heat contents being usually the required quantity. For this reason, the mean Cp is used. The accompanying curves, however, give Cp, both mean and at a point, from both Knoblauch and Jakob and Thomas' experiments. Knoblauch and Jacob obtained, in their experiments the specific heat at a point, and from this obtained the mean specific heat. Thomas did the reverse, obtaining the mean Cp experimentally, and from this, the specific heat at a point. Knoblauch and Jakob only determined a very few points experimentally, exterpolating the rest. Thomas on the other hand, obtained upwards of 100 points to plot their curves, so there is less chance for experimental error in his results.

The principal apparent difference between the results of the two investigations apart from numerical differences at different conditions, lies in the fact that, with Knoblauch and Jakob's experiments, the values of Cp appear to reach a minimum for most pressures—40 pds. and upwards—at an average temperature of about 550 deg. F. or thereabouts, while Thomas' values continue to decrease ad infinitum.

A further investigation of these curves gives the reason the constant value of Cp=.48 was taken by early experimenters. Regnault, for example, found Cp at atmospheric pressure in his experiments. Both of our curves show that for this pressure Cp is approximately constant, and not far from .48 in value It is also interesting to note the great difference in values near the point of saturation, as given by the two experiments. Thomas found very high values at saturation, falling off very rapidly with the first 50 deg. F. of superheat to nearly constant values for the different pressures, while Knoblauch and Jakob found values of Cp nearly constant with all degrees of superheat with the exception of the Cp's at the higher pressures.

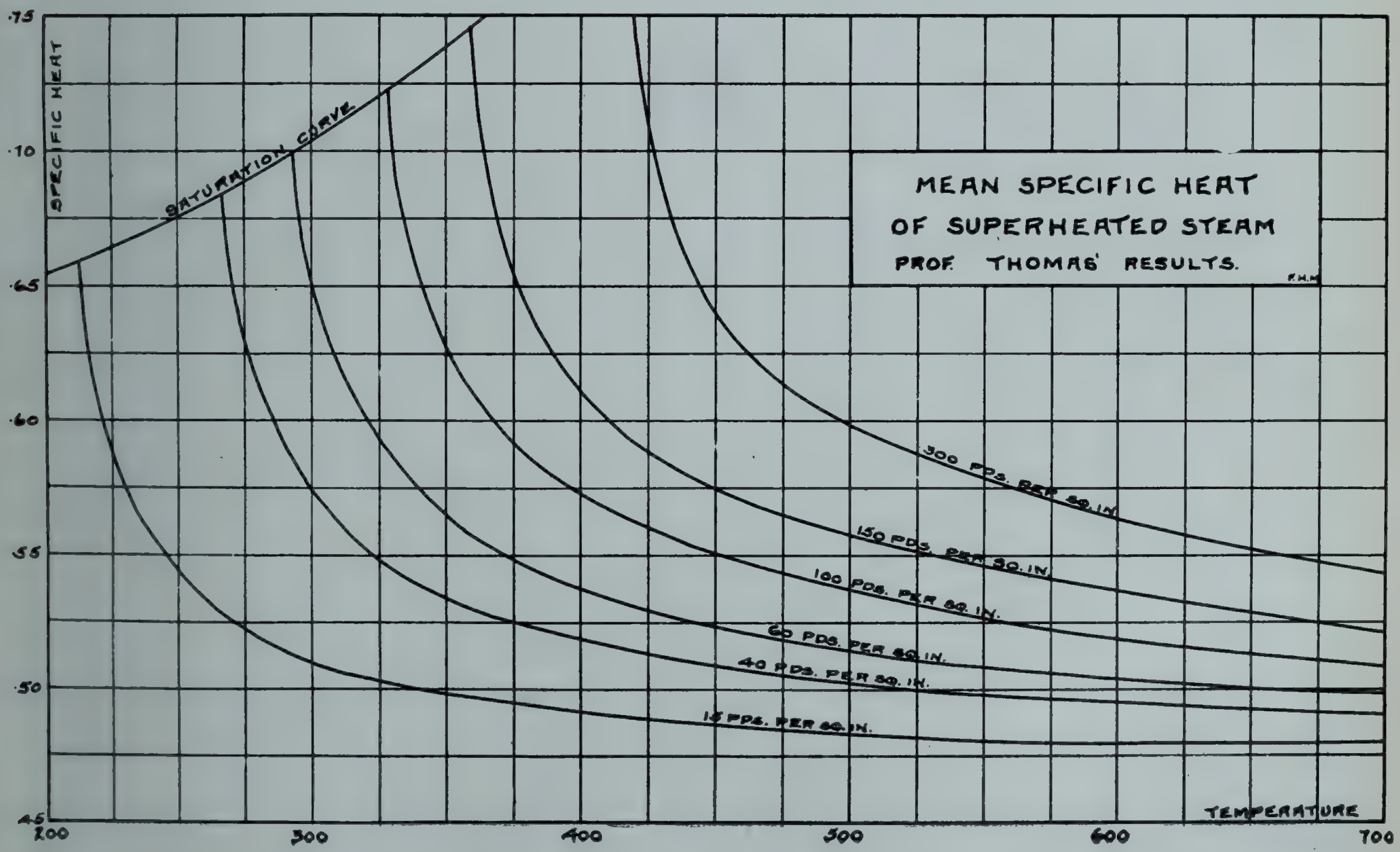
Most American authorities appear to lean toward Thomas' results. In fact, Peabody has prepared his Temperature-Entrop Tables directly from them.

PRECAUTIONS IN ENTERING BOILERS.

By K. Campbell.

It is sometimes necessary for an engineer to enter a boiler when inspecting or repairing it. In such a case the greatest care should be exercised. The fireman and others working around the power plant should be notified, as serious and sometimes fatal accidents have been caused by prematurely opening a valve allowing steam to enter from another boiler. It would be best to have a second man stand guard, while another is in the boiler to watch that no valve connecting with the boiler being repaired or inspected, is tampered with.

Care should also be taken to see that the boiler feed pump is not operated when a man is in a boiler. Before opening a boiler there should be no doubt about the pressure in the boiler. The safety valve should be opened to see that it has fallen to zero, this is the easiest way as the gauge alone is not conclusive evidence that the pressure is at zero. The manhole cover should not be removed until the engineer has satisfied himself that there is no pressure within the boiler.



Repairing of Boilers by the Oxy-Acetylene Method

Description of Method, showing how Oxygen is Produced Commercially---Water-tight Durable Joints are Possible without use of Rivets.

Oxy-acetylene welding has advanced greatly in the past few years, the process becoming widely known throughout Canada by the introduction of the Davis-Bournonville and Linde-British systems. These two as well as the other numerous systems have found many varied applications including the repair of boilers.

It has been suggested that a further development of the system will be the welding of the courses of the shell together, by the oxy-acetylene method instead of riveting them. The difficulty in testing boilers properly to see that the work will stand the required pressure, stands in the way of this system of welding being applied in this way. It is used, however, for repairing crankshafts, cylinders, water jackets of cylinders, locomotive and automobile frames, machinery of all kinds, boilers, etc.

Description of Systems.

All plants require a reliable supply of oxygen and of acetylene, combined through a blowpipe or torch with perfect control of both gases producing a natural flame which is neither oxidizing nor reducing. Pressure gauges are used to regulate the flame approximately, the final regulation being by the appearance of the flame which should be approximately white.

The two systems mentioned previously, the Davis-Bournonville and the Linde British, are typical of the systems in use, the first being a high pressure and the latter a low pressure system. The system is named with reference to the pressure at which acetylene is used.

Acetylene and Oxygen.

Acetylene is produced in all systems by the reaction between calcium carbide and water. In some cases calcium carbide is fed into water and in other cases water is fed into calcium carbide, but the calcium-fed generator is in most common use.

In producing oxygen the Davis-Bournonville use the chlorate of potash system. Chlorate of potassium is mixed with black manganese dioxide and heated in a closed vessel, driving off the oxygen gas. The Linde British system is the most unique of all systems. The oxygen is obtained from the atmosphere by a process of liquefaction and partial evaporation which separates the oxygen from the nitrogen of the air. Other methods are also in use such as electrolysis, producing from lavoisite, oxygenite, etc.

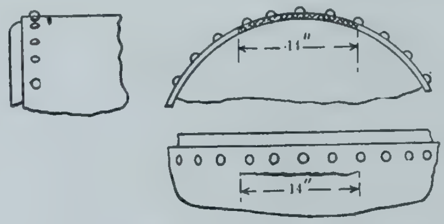
The consumption of acetylene is about 3 cubic feet per hour for each 3-64-inch of thickness of plate and about 1.7 times as much oxygen. A joint of this thickness plate can be made at a rate of about 5 feet per hour.

Repairing Boilers.

The oxy-acetylene method of repairing boilers is finding favor with engineers and the number of applications is increasing. Instead of putting a patch on a boiler, a joint may be made with an oxy-acetylene torch. This makes a durable water-tight joint without the use of rivets. This method of repairing boilers has been used where formerly boilers had to be removed from their settings. Portable apparatus allows repairs being made very quickly.

Marine boilers may also be repaired by this method and the illustration shows a 14-inch crack in a marine boiler. This was repaired by the oxy-acetylene method without disturbing the machinery.

The use of the oxy-acetylene method in boiler work necessitates great care as considerable skill is required for this class of work, but it is satisfactory when well done. When a weld is badly made and a minute crack left at the bottom of the plates, it will open up when pressure is put on the boiler, because of the constant expansion and contraction formed by the raising and lowering of the boiler pressure. Well-made welds show a strength of from seventy-five to eighty-five per cent. of the plate which is a good showing.



Repairing Boilers by Oxy-Acetylene Welding.

Cutting Boiler Plate.

Oxy-acetylene is found to be very economical for cutting off iron plates and is used in numerous boiler shops in the United States for cutting these shapes. In using the cutting tool, a separate pipe with a nozzle carrying oxygen under high pressure is attached to the welding torch. Eighty-four feet of ½-inch thick plate has been cut in one hour with a Davis-Bournonville outfit.

CANADIAN RAILWAYS.

"Railway Development in Canada," was the subject of an address delivered at the Engineers' Club, Toronto, recently, by R. A. Baldwin, resident engineer of the Canadian Northern Railway. After referring to the views entertained by the English people less than a century ago, when George Stephenson proposed the construction of a railway, Mr. Baldwin traced the development of Canada's system of transcontinental lines. The first railroad in this country, he pointed out, was known as the Champlain & St. Lawrence, and was opened in July, 1836, and was but sixteen miles in length. Last year there were 24,104 miles of railway in Canada, employing 125,000 people, and the aggregate earnings for the twelve months amounted to $145,-000,000.

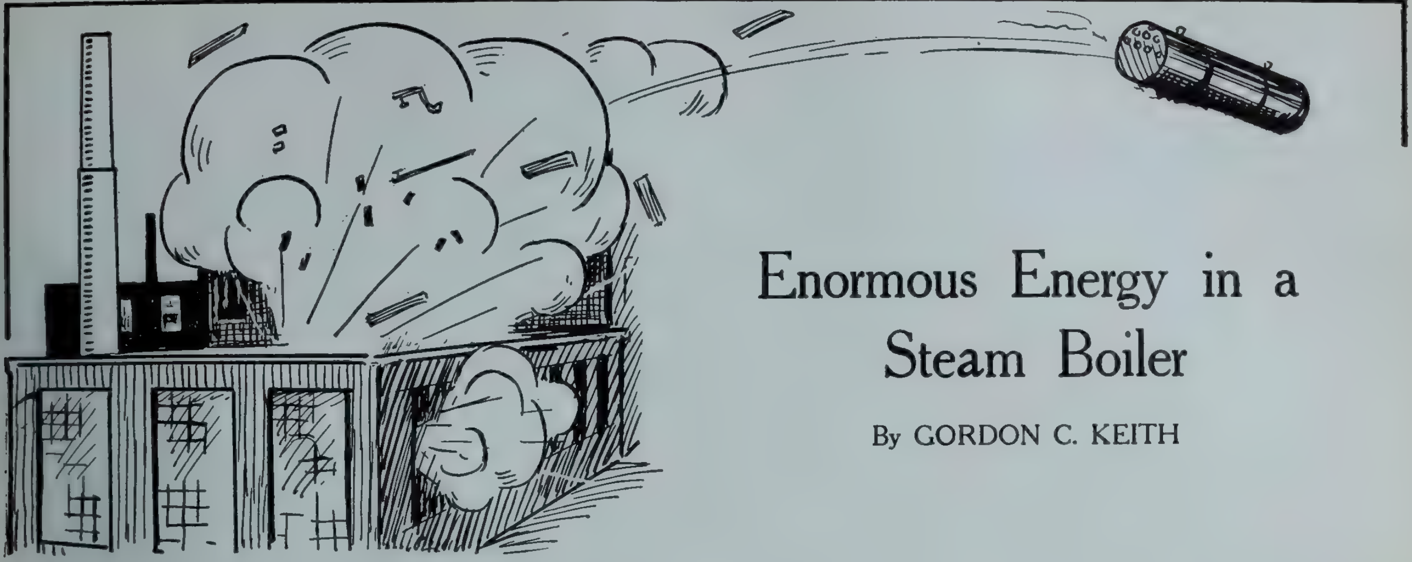
In 1896 the first train was run on the Canadian Northern system; the earnings for the first year were $60,000, and the staff numbered about twenty. Now, west of Port Arthur alone, the earnings were on a basis of ten millions a year, and 10,700 persons were on the regular pay-roll. Soon, too, the Grand Trunk Pacific would be doing business across the continent.

On the motion of A. B. Barry the facts set forth at the meeting of the Club relative to the development of the country will be forwarded to the High Commissioner for Canada in London and placed before the British investors. Prof. Angus, of Toronto University, presided.

The equipment of models and other apparatus belonging to the dissolved Montreal No. 1 C.A.S.E., has been secured for the engineering classes conducted by Peter Bain, of Bain & Mitchell, consulting engineers, Y.M.C.A. Building, Montreal, making it now one of the best equipped private schools for firemen, engineers, mechanics and draughtsmen in the Dominion.

Instruction is given in day and evening classes and by correspondence, individualism being made a feature. To those desirous of improving themselves along technical lines, exceptional facilities are to be had at moderate rates. Applications to be made to Mr. Bain.

By rigging up a cross slide on the commutator end of his generator and by turning down the commutator about a sixteenth of an inch with a diamond point lathe tool, one factory superintendent effectively stopped sparking at the brushes. This method succeeded after all others had failed. Emery cloth should never be used on a dynamo commutator.



Enormous Energy in a Steam Boiler

By GORDON C. KEITH

As an engineer performs his daily task about the engine room or the fireman feeds coal into the furnace, perhaps it never occurred to either of them, that under their care was a machine in which is sufficient potential energy to blow the boiler from one to three miles, leaving a damaged building and a great amount of wreckage in its wake.

Perhaps there has not been a greater number of explosions in the United States and Canada this year than usual, but the potential energy in a boiler has been more forciably impressed upon our minds this year, than ever before, by the publicity given to the explosions that have occurred. It all impresses the engineer with the care that must be taken of a boiler, and the proprietor with the fact that he should assist in the education of his engineers and firemen to avoid such a calamity as an explosion. The education of the engineer is the best insurance a proprietor can have against the wreck of and damage to his plant.

Reports of explosions in Canada have been recorded in "The Power House" from time to time. In some cases a boiler which should have been in the scrap heap years ago has been the cause, in others the safety valve and other various causes. In some cases the cause will never be known, but it all points to the stored up energy in the boiler.

Boilers must be first of proper design. This is the reason for the various provinces of Canada and the Canadian Manufacturers' Association taking such an interest in the proper design and construction of boilers. It will help to protect life and property.

Second, an engineer must understand how to care for a boiler, and for this reason he must be educated. Governments have recognized this and the engineer's certificate is a result. An engineer must keep his boiler clean, guard against corrosion and see that his boiler is properly repaired when repairs are found necessary.

Energy of Steam.

The energy in steam can be measured in one way by the number of heat units abstracted from it. For instance every pound of steam entering the engine from the boiler carries with it a certain number of heat units. When the steam is exhausted a lesser number is carried away. The difference has been converted into work. If the heat units entering into each pound of the fluid were measured before and after entering the engine, the difference will give the number of units that were converted into work, in the ideal case at least, for each pound of steam. As each heat unit is equivalent to 778 foot-pounds, the work of the pound of steam or of any number of pounds, can be obtained. This represents the energy that is obtained from a boiler through an engine, by the engineer.

Properties of Saturated Steam.

Gauge Pressure, lbs. per sq. in.	Absolute Pressure, lbs. per square inch.	Temperature Fahrenheit.	Total Heat above 32° F.		Latent Heat L. $= H - h$. Heat-units.	Relative Volume. Vol. of water at 39° F. = 1.	Volume. Cu. ft. in 1 lb. of Steam.	Weight of 1 cu. ft. Steam. lb.
			In the Water h Heat-units.	In the Steam H Heat-units.				
145.8	160	363.3	335.9	.7	856.9	173.9	2.80	.3567
146.8	161	363.8	336.4	.9	856.5	172.9	2.79	.3588
147.8	162	364.3	336.9	1193.0	856.1	171.9	2.77	.3609
148.8	163	364.8	337.4	.2	855.8	171.0	2.76	.3630
149.8	164	365.3	337.9	.3	855.4	170.0	2.74	.3650
150.8	165	365.7	338.4	.5	855.1	169.0	2.72	.3671
151.8	166	366.2	338.9	.6	854.7	168.1	2.71	.3692
152.8	167	366.7	339.4	.8	854.4	167.1	2.69	.3713
153.8	168	367.2	339.9	.9	854.0	166.2	2.68	.3734
154.8	169	367.7	340.4	1194.1	853.6	165.3	2.66	.3754

Fig. 1.—Properties of Saturated Steam.

The total energy of the steam in the boiler is much greater than that obtained through a steam engine. The ordinary boiler in Canada carries a boiler pressure of from 100 to 150 pounds pressure. An example was recently given by the Fidelity and Casualty Co., New York in which the total pressure of steam and water is calculated for a horizontal tubular boiler carrying 150 lbs. pressure, 80 cu. ft. steam space and 160 cu. ft. water space.

The energy in a pound of steam at 150 pounds, liberated by explosion, and expanded down to 212° Fahr. is 134,521.2 ft.-lbs. (A "Manual of Steam Boilers," by Prof. R. H. Thurston, table entitled "Total Available Energy in Water and Steam.")

In Fig. 1 is a portion of a table giving the properties of saturated steam, reproduced from Kent's handbook. At 150 lbs. pressure, the table shows the weight of 1 cu. ft. steam to be .3671 lbs. The total weight of steam is therefore 80 X .3671 equals 29.37 lbs. and the total energy of the steam is 134,521 X 29.37 equals 3,950,882 ft. lbs.

Energy of Water.

The greater energy in a steam boiler is in the water. In Fig. 2 is a table reproduced from "Steam," a book issued by Babcock & Wilcox, which gives the weight of a cubic foot of water at various pressures. At 150 lbs. pressure the weight is 61.16 lbs. The total weight of the water in the boiler is therefore 61.16 X 160 equals 9,785.6 pounds.

The energy in each pound of water at 150 lbs. pressure that would be liberated by explosion and expansion down to 212 deg. F. is 11,823.4 ft.-lbs. The total energy of the water is therefore 11,823.4 X 9,785.6 equals 115,699,062 ft.-lbs. It is interesting to note that the total energy of the water is about twenty-five times greater than the total energy of the steam, and is the more dangerous content of the boiler.

The total energy of both steam and water are 3,950,882 ft.-lbs. X 115,699,062 ft.-lbs. equals 119,649,944 ft.-lbs., a power sufficient to blow an ordinary boiler about two miles. Fig. 3 is a table from an engineer's handbook showing energy in a steam boiler.

WATER BETWEEN 32° AND 212° F.

Temperature Fahr.	Heat Units per lb.	Weight lb. per cub. ft.	Temperature Fahr.	Heat Units per lb.	Weight, lb. per cub. ft.
32°	0·00	62·42	145	113·26	61·28
35	3·02	62·42	146	114·27	61·26
40	8·06	62·42	147	115·28	61·24
45	13·08	62·42	148	116·29	61·22
50	18·10	62·41	149	117·30	61·20
52	20·11	62·40	150	118·30	61·18
54	22·11	62·40	151	119·31	61·16
56	24·11	62·39	152	120·32	61·14
58	26·12	62·38	153	121·33	61·12
60	28·12	62·37	154	122·34	61·10
62	30·12	62·36	155	123·34	61·08
64	32·12	62·35	156	124·35	61·06
66	34·12	62·34	157	125·36	61·04
68	36·12	62·33	158	126·37	61·02
70	38·11	62·31	159	127·38	61·00
72	40·11	62·30	160	128·38	60·98
74	42·11	62·28	161	129·39	60·96
76	44·11	62·27	162	130·40	60·94
78	46·10	62·25	163	131·41	60·92
80	48·09	62·23	164	132·42	60·90
82	50·08	62·21	165	133·42	60·87
84	52·07	62·19	166	134·43	60·85
86	54·06	62·17	167	135·44	60·83
88	56·05	62·15	168	136·45	60·81
90	58·04	62·13	169	137·46	60·79
92	60·03	62·11	170	138·46	60·77
94	62·02	62·09	171	139·47	60·75
96	64·01	62·07	172	140·48	60·73
98	66·01	62·05	173	141·49	60·70
100	68·01	62·02	174	142·50	60·68
102	70·00	62·00	175	143·50	60·66
104	72·00	61·97	176	144·51	60·64
106	74·00	61·95	177	145·52	60·62
108	76·00	61·92	178	146·53	60·59
110	78·00	61·89	179	147·54	60·57
112	80·00	61·86	180	148·54	60·55
113	81·01	61·84	181	149·55	60·53
114	82·02	61·83	182	150·56	60·50
115	83·02	61·82	183	151·57	60·48
116	84·03	61·80	184	152·58	60·46
117	85·04	61·78	185	153·58	60·44
118	86·05	61·77	186	154·59	60·41
119	87·06	61·75	187	155·60	60·39
120	88·06	61·74	188	156·61	60·37
121	89·07	61·72	189	157·62	60·34
122	90·08	61·70	190	158·62	60·32
123	91·09	61·68	191	159·63	60·29
124	92·10	61·67	192	160·63	60·27
125	93·10	61·65	193	161·64	60·25
126	94·11	61·63	194	162·65	60·22
127	95·12	61·61	195	163·66	60·20
128	96·13	61·60	196	164·66	60·17
129	97·14	61·58	197	165·67	60·15
130	98·14	61·56	198	166·68	60·12
131	99·15	61·54	199	167·69	60·10
132	100·16	61·52	200	168·70	60·07
133	101·17	61·51	201	169·70	60·05
134	102·18	61·49	202	170·71	60·02
135	103·18	61·47	203	171·72	60·00
136	104·19	61·45	204	172·73	59·97
137	105·20	61·43	205	173·74	59·95
138	106·21	61·41	206	174·74	59·92
139	107·22	61·39	207	175·75	59·89
140	108·22	61·37	208	176·76	59·87
141	109·23	61·36	209	177·77	59·84
142	110·24	61·34	210	178·78	59·82
143	111·25	61·32	211	179·78	59·79
144	112·26	61·30	212	180·79	59·76

Fig. 2.—Weight of Water.

The Power Illustrated.

In Fig. 4 is shown a sketch of a return tubular boiler which exploded at Chewtown, Pa., recently. The boiler which exploded was 60 inches in diameter by 16 feet long, and contained 54 four-inch tubes. It was made up of 5-16 inch plates, with double-riveted lap-joint longitudinal seams, using ¾-inch rivets in 13-16 inch holes pitched 1⅞ inches from centre to centre. The heads were of ½-inch steel plate. In addition to this ordinary construction the boiler was fitted with a large horizontal steam drum 32 inches in diameter by 8 feet long, connected to the shell through two 12 inch necks. The manhole was in the rear course, as shown in Fig. 4.

The steam drum was blown on top of a hill over 200 feet high and landed in two pieces, fully a quarter of a mile from the plant. The drum broke in two at the curvilinear seam, and the two pieces landed within 500 feet of each other. The back course pulled completely away from the rest of the boiler around the circular seam, and also let go longitudinally through the centre line of the manhole.

Explosion at Canton.

The recent deplorable explosion at Canton, O., is another example of the enormous energy stored within the boiler shell. Thirteen men lost their lives. The body of the fireman was blown like a cannon ball a distance of several hundred feet, over a number of buildings, completely through the second story of a residence, tearing cleanly through both walls, out the other side, and through a fence in an adjacent yard, finally landing on the ground and tearing up a wide furrow.

TOTAL STORED ENERGY OF STEAM BOILERS.

TYPE.	Area of		Pressure, Pounds Per Square Inch	Rated Power. H.P.	Weight of			Available Stored Energy in			Energy Per Lb. of		Maximum Height of Projection.*		Initial Velocity.	
	Grate Surf.	Heat Surf			Boiler.	Water.	Steam.	Water.	Steam.	Total.	Boiler.	Total Weight	Boiler.	Total.	Boiler.	Total.
	Sq. Feet.				Pounds.			Foot Pounds.			Foot lbs.		Feet.		Ft Per Sec.	
1. Plain Cylinder	15	120	100	10	2500	5764	11 325	46605200	676698	47281898	18913	5714	18913	5714	1103	606
2. Cornish	36	730	30	60	16950	27471	31.45	57570750	709310	58280060	3431	1314	3431	1314	471	290
3. Two.flue Cylinder	20	400	150	35	6775	6840	37 04	80572050	2377357	82949407	12243	6076	12243	6076	888	625
4. Plain Tubular	30	852	75	60	9500	8255	20 84	50008790	1022731	51031521	5372	2871	5372	2871	588	439
5. Locomotive	22	1070	125	525	19400	5260	21 67	52561075	1483896	54044971	2786	2189	2786	2189	423	375
6. Locomotive	30	1350	125	650	25000	6920	31 19	69148790	2135802	71284592	2851	2231	2851	2231	428	379
7. Locomotive	20	1200	125	600	20565	6450	25 65	64452270	1766447	66218717	3219	2448	3219	2448	455	397
8 Locomotive	15	875	125	425	14030	6330	19 02	64253160	1302431	65555591	4677	3213	4677	3213	549	455
9. Scotch Marine	32	768	75	800	27045	11765	29 80	71272370	1462430	92734800	2689	1873	2689	1873	416	348
10. Scotch Marine	50.5	1119.5	75	350	37972	17730	47 20	107408340	2316392	106724732	2889	1968	2889	1968	431	356
11. Flue and return tubular	72 5	2324	30	200	56000	42845	69 81	90531490	1570517	92101987	1644	931	1644	931	325	245
12. Flue and return tubular.	72	1755	30	180	56000	48570	73 07	102628410	1643854	104272264	1862	996	1862	996	346	253
13. Water Tube.	70	2806	100	250	34450	21325	35.31	172455270	2108110	174563380	5067	3073	5067	3073	571	445
14. Water Tube	100	3000	100	250	45000	28115	58 50	227366000	3513830	230879830	5130	3155	5130	3155	575	450
15 Water Tube.	100	3000	100	250	54000	13410	23 64	108346670	1311377	109624283	2030	1626	2030	1426	361	323

* This means the height to which the boiler, or boiler and contents, would be thrown if it went up in one piece, and hence all in one direction.—E. D. M.

Fig. 3.—Stored Energy in Steam Boilers.

The top sheet of the boiler which exploded was hurled 1,000 feet over the top of a building into a field beyond. A twisted steel bar dropped like a bomb through a residence 300 feet away. The concussion was so great that houses within a radius of half a mile suffered heavily from broken windows.

The boiler was of the ordinary horizontal tubular type, 66 inches diameter, 16 feet long, built of ⅜-inch plate with double-riveted lap seams, and allowed a working pressure of 95 pounds by the Hartford Steam Boiler Inspection & Insurance Co. The shell was constructed of two full-length plates, with longitudinal seam along each side. Every rivet in both seams was sheared cleanly and sharp.

Destructive Possibilities.

The destructive possibilities of a boiler can best be realized by the above recent explosions. Many explosions have occurred within our own borders, a number of them being described in minute detail. The potential energy is different in the various types. W. L. Durand in a recent issue of The National Engineer gives a comparison of the destructive possibilities of the different types, plain cylinder, plain tubular, locomotive and water tube.

The energy in the plain cylinder boiler is about 19,000 foot pounds per pound of boiler. This means that the energy in the boiler is sufficient to throw the boiler nearly four miles high with an initial velocity of 1,100 feet per second. This form of boiler is the most destructive of the four and when exploded the consequences are usually exceptionally disastrous.

The energy in the plain tubular boiler, which seems to be the type causing the majority of the worst explosions at the present time, is about 5,300 foot pounds per pound of weight and if this energy were all imparted to the boiler by an explosion the resulting initial velocity would be about 590 feet per second with a maximum distance traveled of a mile.

In the case of a locomotive boiler, due to the fact that weight is an important factor, the amount of water is reduced and the average energy per lb. of boiler is about 3,000 foot pounds.

In the water tube boiler the energy per pound of boiler is extremely variable ranging from 2,000 to 3,000 foot pounds. But in this type of boiler the water is so distributed through the tubes that when an explosion takes place, a considerable time interval occurs before all the water has escaped, and consequently the explosive force of the steam, being applied gradually, the damage resulting is much less than in any other type of boiler.

Engineers Must Exercise Care.

It is to be hoped that the engineer or fireman reading this article will exercise the greatest care to prevent the destruction of life and property due to boiler explosions. In the case of the boiler at Chewtown, it had twice been discarded and was badly patched. Engineers should refuse to operate old boilers.

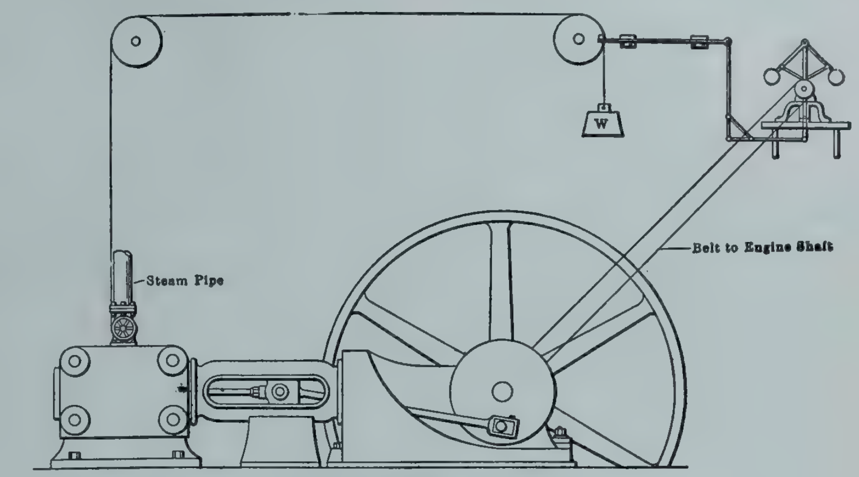
Regular and frequent tests should be made of the safety valve. The boiler should be kept clean. Take every care to have everything in proper condition in the morning before getting up steam. Another thing to watch carefully is the patching of a boiler. Frequently it becomes necessary to make repairs and it should be attended to by an expert. Of course the engineer should oversee it and understand how it should be done, but an expert should be hired to do the job. A proper repair is then ensured. A machine with the destructive possibilities and of such enormous potential energy should be given every attention to keep it in good working condition and eliminate every possible chance of explosion.

HOME-MADE ENGINE STOP.

Some time ago the writer happened to be in the engine room of a manufacturing plant, when his attention was attracted to a rather ingenious device in the way of a home-made engine stop, says Edward T. Binns in Power. The engineer explained that from some cause the engine had run away several times and in each instance disaster was narrowly averted. Accordingly, he had set about to produce an automatic engine stop at small cost. The accompanying sketch gives an idea of his apparatus. It is reported to have fulfilled its function faithfully several times.

There is a detachable drum fastened to the throttle of the engine with enough sash cord wound on it to correspond with the threads on the stem of the valve. The cord is run over pulleys and connected with a weight of sufficient size to unwind the cord from the drum as it descends, thus closing the throttle. Ordinarily the cord is wound on the drum and the weight suspended at sufficient height entirely to shut off steam in its descent. The drum comes off for starting and stopping and is placed on a hook out of the way.

The scheme for releasing the weight is that of a sliding bar, one end of which is caught under a pin in one edge of the pulley directly over the weight. As it is barely caught, an endwise movement of ½-inch will release the weight. The other end of the bar is connected to the upper end of a bell crank which is hinged at the elbow. The longitudinal arm of the bell crank is in contact with the stem of an ordinary flyball governor, which in turn is connected by a belt to the engine shaft. The stud of this governor is adjusted so that it will not act until the engine has reached a speed beyond the range of the regular governor, at which time the stem is passed downward, causing the weight to be released and a prompt shut-down is the result.



A Homemade Engine Stop.

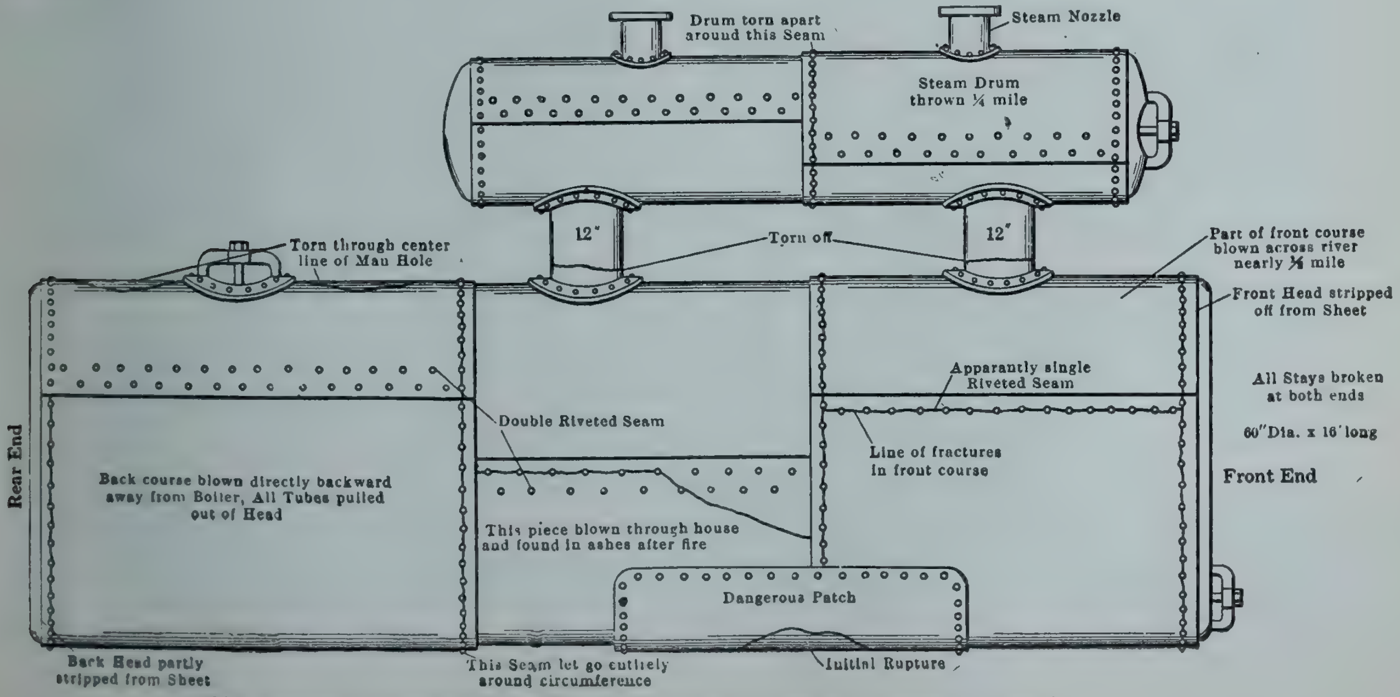

Drum torn apart around this Seam
Steam Nozzle
Steam Drum thrown ¼ mile
12"
Torn off
12"
Torn through center line of Man Hole
Part of front course blown across river nearly ⅛ mile
Front Head stripped off from Sheet
Apparantly single Riveted Seam
All Stays broken at both ends
60"Dia. x 16' long
Double Riveted Seam
Line of fractures in front course
Rear End
Back course blown directly backward away from Boiler, All Tubes pulled out of Head
Front End
This piece blown through house and found in ashes after fire
Dangerous Patch
Back Head partly stripped from Sheet
This Seam let go entirely around circumference
Initial Rupture

Fig. 4.—Sketch of Chewtown Boiler Showing the Lines of Fracture.—(Courtesy of Power.)

TEST OF WEBSTER HEATING SYSTEM.

The accompanying diagram shows the results of a test made of the Webster "Q.R" Modulation System of Steam Heating, recently installed in an office and warehouse building in Montreal. The test being made during seven days of changeable weather last winter.

The advantages claimed by the use of low pressure steam heating, are clearly shown by the diagrams, first, the even temperature that is maintained in all parts of the building with any change of outside temperature. This fact shows the ability to regulate the temperature in any room at the will of the occupant. In order to obtain this result, the Wesbster Modulation Valve was used on each unit, a cut of which is shown in Fig. 1. It will be noticed that the valve is graduated to four deg. thus if required, diminishing or increasing the amount of heat given off from the radiators at will.

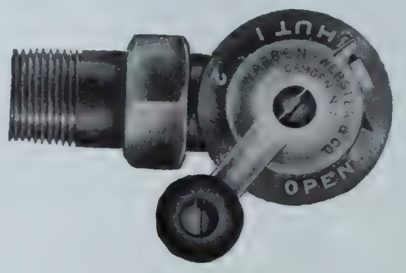


Fig. 1.—Webster Valve Used.

Corresponding to the steam control, will be noticed the low coal consumption in mild weather, the minimum of which during this test was 300 lbs. in 24 hours, with an average temperature of about 22 degrees Fahr., a fall of temperature to 12 degrees Fahrenheit, gave a consumption of 625 lbs. in 24 hours, i.e., one pound of coal per 57.75 square ft., of surface per hour. This result will show the economy and low cost of working the system.

The system in general is very simple both in its construction and operation, it requiring only the services of a janitor or fireman to keep it in perfect order.

A favorable feature of the system is the absence of "water hammer action." This is owing to the use of the Webster water seal motor on each unit, and at the end of long runs in supply mains.

The building is about 120,000 cub. ft., three storeys high, and is exposed on three sides, the total radiation surface is 1,500 square feet.

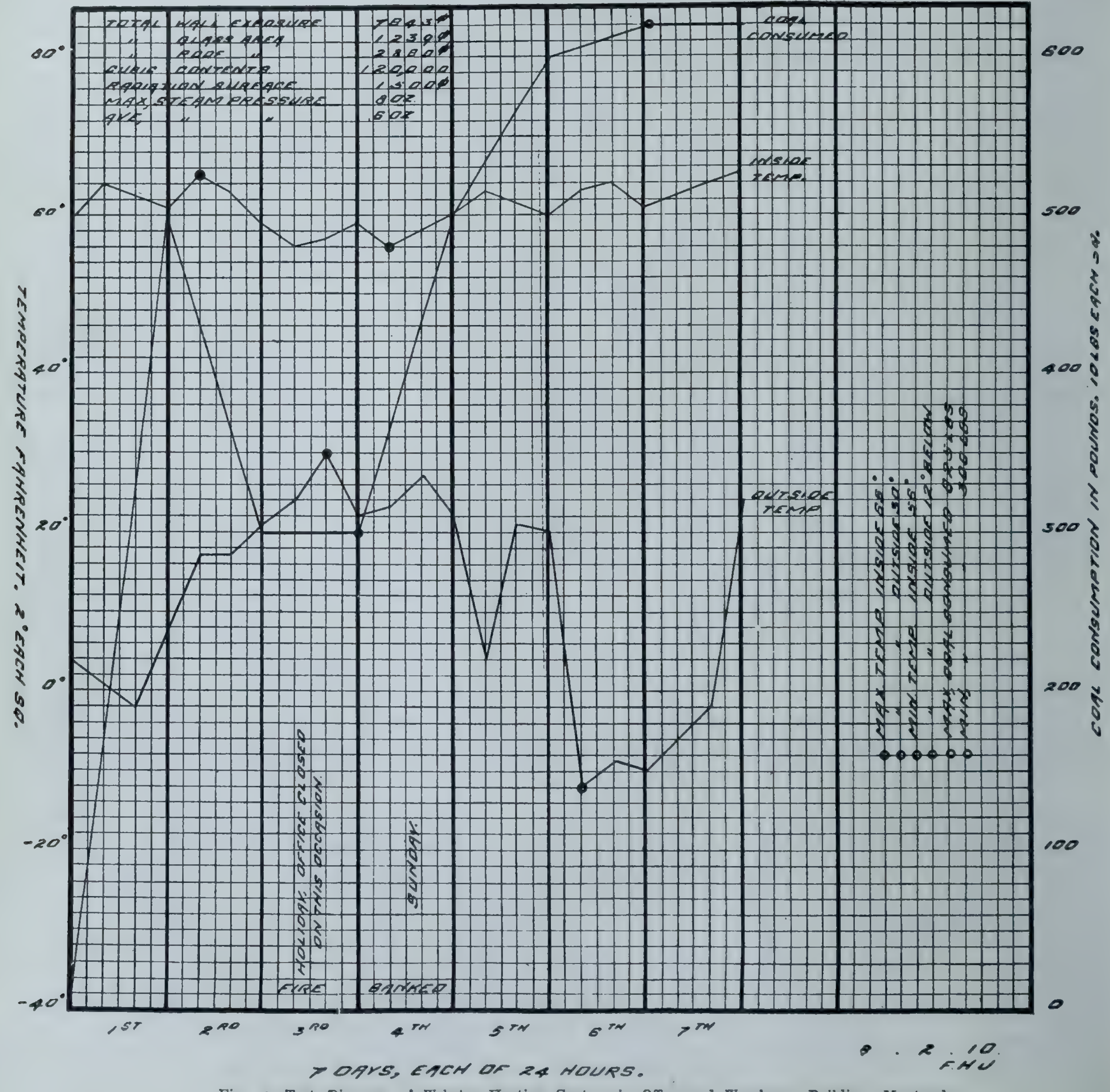


Fig. 2—Test Diagram of Webster Heating System in Office and Warehouse Building, Montreal.

Handling Heating System Condensation Economically

Some Interesting Features in Connection with the Heating of the New I.C.R. Shops, Moncton, N.B., Handling Condensation, Feed Water Control.

By H. L. Peiler.

One of the recent issues of "The Power House" dealt with the general features of the mechanical instalation in the new shops of the Intercolonial Railway at Moncton, N.B., and described at some length the interesting details of the power house with its large Westinghouse Gas Engine, its producer plant and the boiler equipment generally.

The present article proposes to take up another part of the equipment, which has an important bearing on the fuel consumption and the general efficiency of the heating system, namely, the method employed to return the water of condensation to the power house and back into the boilers independetly of the feed-pumps.

Indirect radiation is used for heating all the various buildings with the exception of the stores and office building, which is heated by direct radiation.

A reference to the accompanying plan will make clear the general system employed. In the boiler house itself are two large fan stacks, from one of which the warmed air is forced through a duct for distribution in the freight-car repair shop, while the other supplies warm air to the blacksmith shop. Two more fans supply the large machine shop and the engine erecting shop. A fifth supplies the passenger car repair shop, a sixth the passenger-car paint shop, and a seventh fan-stack heats the planing mill.

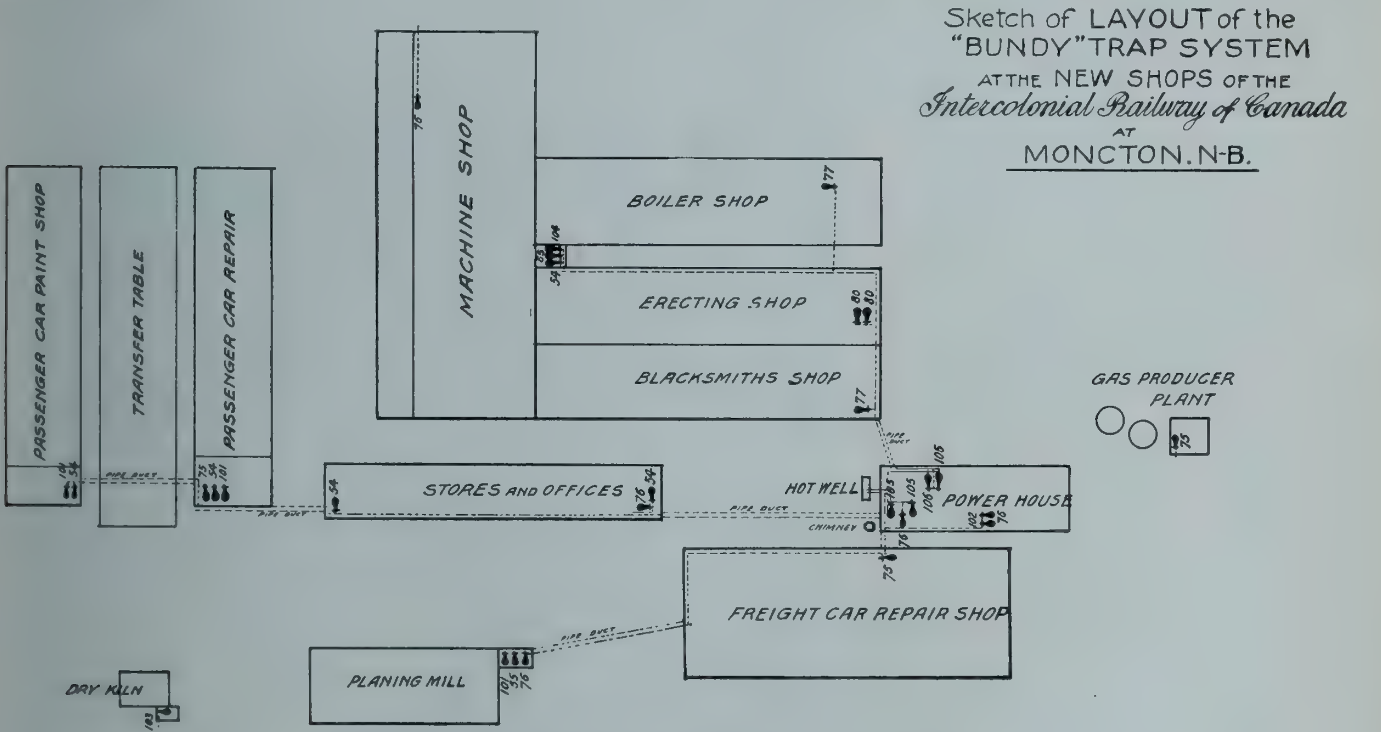


Fig. 1.—Plan Showing Layout of Traps, I. C. R., Moncton.

Live steam is, of course, carried to all these points, and some of the distances are considerable as the longest run, namely, to the passenger-car paint shop, is 1,200 feet from the power house. Each Sturtevant fan is operated by steam, the fan engine exhausting into the first two sections of the stack, while the rest of the stack is supplied with live steam at a pressure of 50 to 60 lbs., reduced from the boiler pressure of 125 lbs.

Besides the steam used for heating purposes, high pressure steam is also required in the engine shop for the lye-pots, and in the power house for operating the large air compressor and the fire pump, and steam is also required in the gas-producer house, for heating and other purposes.

The problem of handling the condensation throughout this large plant, with all its various pressures, high, medium and low, and the different purposes for which steam is being used under practically every condition save that of actual vacuum, presented many interesting features which required careful consideration.

It was decided to adopt a suggestion to handle the whole plant automatically with steam-traps, and Bundy trap representatives were called upon to lay out a return system, which was eventually installed and has now been in successful operation for considerably over a year.

Beside each fan stack two traps are placed, one a Bundy steam-operated lifting pump trap taking the exhaust condensation from those coils that are fed by the fan engines, the other a Bundy tank or separating trap on the coils supplied with live steam. These traps do not discharge into the same return line, as the exhaust condensation contains a percentage of cylinder oil and is therefore, pumped to the general hot-well, where it is purified before being handled by the boiler-feed pump.

All the live steam returns from the 40, 60 and 125 lbs. lines, all the drips of the supply-mains, the lye-pots and the direct radiation, are trapped with Bundy traps of the standard tank type, which discharge overhead in the boiler-house into a closed receiver-tank situated over the boilers. From this receiver the water flows by gravity to two large return traps which discharge it automatically into the boilers. In designing this system, the greatest difficulty lay in determining with accuracy the quantity of water that would have to be handled by the traps. The general conditions of concrete and glass construction, combined with forced draft in the indirect heating system, pointed to a high prospective condensation ratio in the piping. The government engineers had only very incomplete data furnished by the blower manufacturers, and it was anticipated that the two 600 h.p. Babcock & Wilcox boilers would be ample for heating purposes besides furnishing power for the compressor and pumps. On the other hand the condensation engineer calculated that the heating apparatus alone would condense almost as much steam as could be furnished by these boilers, and the trap system was based upon his calculations which were afterwards proven to be correct. The two return traps, each with a capacity of 250 pounds of water per operation, and returning to the boilers under normal activity, (that is dumping once per minute) are able to return 30,000 lbs. of water per hour, and can work 50 p.c. overload if necessary. They are busy traps during cold weather, and have frequently returned to the boilers, water equivalent to an evaporation of 1,200 h.p. It was early found necessary to add two more boilers of 250 h.p. each, and the four boilers are just comfortably able to take care of their load.

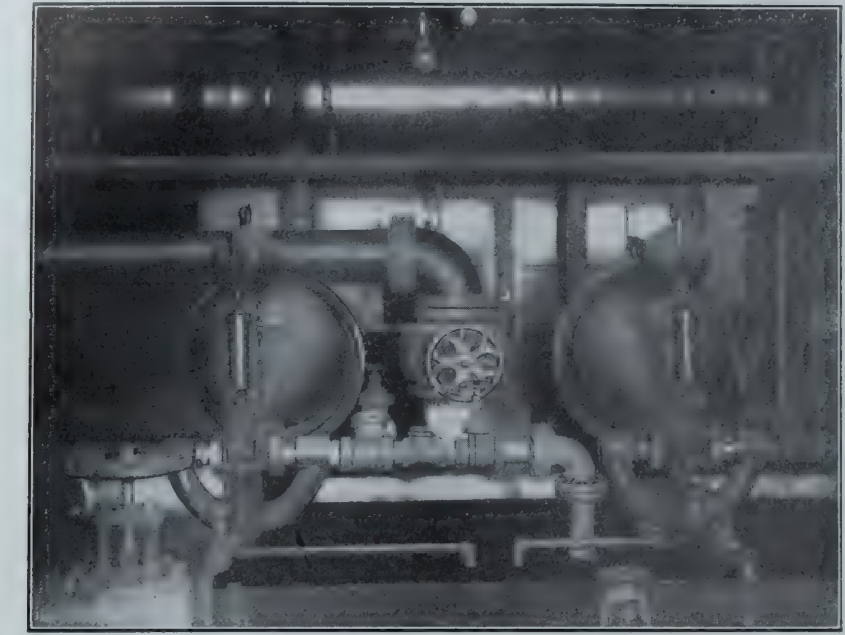


Fig. 2.—An Installation of Bundy Traps, I. C. R., Moncton, Showing Connections.

Lye-pots and Dry Kilns.

Among the curiosities of condensation met with in this plant, was that that of the enormous amount of water condensed by the coils in the lye-pots. It was found necessary to instal on 400 feet of 1½ inch pipe, a trap with a full valve opening of 1 inch. When one takes into consideration that the initial pressure on this piece of piping is 125 lbs. and further remembers the large quantity of water that can be forced through an opening of one inch diameter with this pressure, facts are presented that make all ordinary rules for calculating condensation ratios look very ridiculous.

Another interesting feature is the method of taking water from the dry-kilns which are supplied with steam by an independent boiler beside the kilns. Here, instead of placing a separating trap on the coils, these discharge into a small closed receiver which has a discharge pipe running almost to its bottom. The pressure on the receiver forces the water up this discharge pipe to a Bundy return trap over the boiler, which in turn puts the water back into the boiler. A continuous circulation is thus maintained from the boiler through the kiln coils and back into the boiler again, although the coils are actually some 12 feet below the water-line of the boiler.

In this whole system there are 30 traps, and the up-keep cost during the 15 months of operation has been less than $3.00. The economy is very marked, the whole arrangement is entirely automatic, the return water reaches the boilers again at an average temperature of about 235 deg. F., and the work has resulted in another practical demonstration that the trap method of controlling and returning condensation, is an economical method of effecting savings in steam-using establishments.

Feed Water Control.

Engineers will probably be also interested in one other feature of boiler-feeding by this system. Each of the B. & W. boilers is equipped with the Berry Automatic Safety Feed Water control, regulating the make-up supply from the feed pump and there was an element of doubt as to whether the admission of considerable quantities of water into the boilers by means of these large return traps would not disturb the water level to such an extent as to interfere with the working of the automatic feed-control. However, it was found in operation that water flowing into the boilers by gravity from the

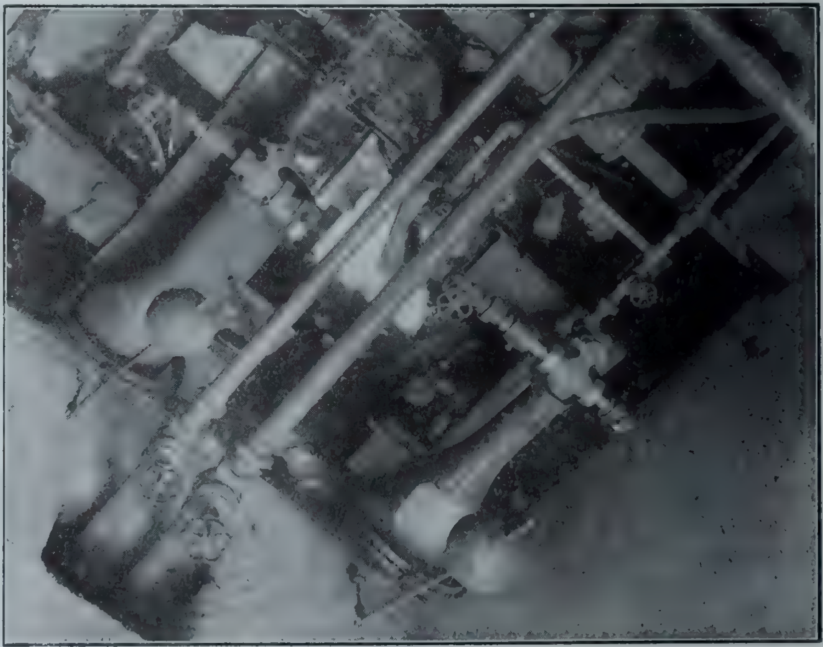


Fig. 3.—Two Bundy High Pressure Taking Condensation From Coils in Lye Pots and Water Heater in Erecting Shop, I. C. R., Moncton, Both Traps Elevate the Water 40' and Discharge to Receive 500' Distant in Boiler House.

traps seeks its level by first supplying those boilers whose water-line is lowest. There has not been any variation in the water-level of these four boilers since they were installed, and the automatic control of the make-up water works perfectly in conjunction with the traps, even though the latter are feeding into the boilers nearly two-thirds of the water which is evaporated.

The instalation was made by Peiler & MacKenzie of Montreal, with the assistance of John Sabin, Boston, supervisor of the Bundy Department of the American Radiator Company.

TEMPERATURE CAMPARISONS.

Temperature is the state of a body with reference to its power of communicating heat to or receiving heat from other bodies. The direction of the flow of heat determines which of the two bodies has the higher temperature. Thus if a body X is brought in contact with body Y, and X loses and Y gains in heat, then X is said to have had originally a higher temperature than Y. If neither body gains or loses, then both had the same temperature.

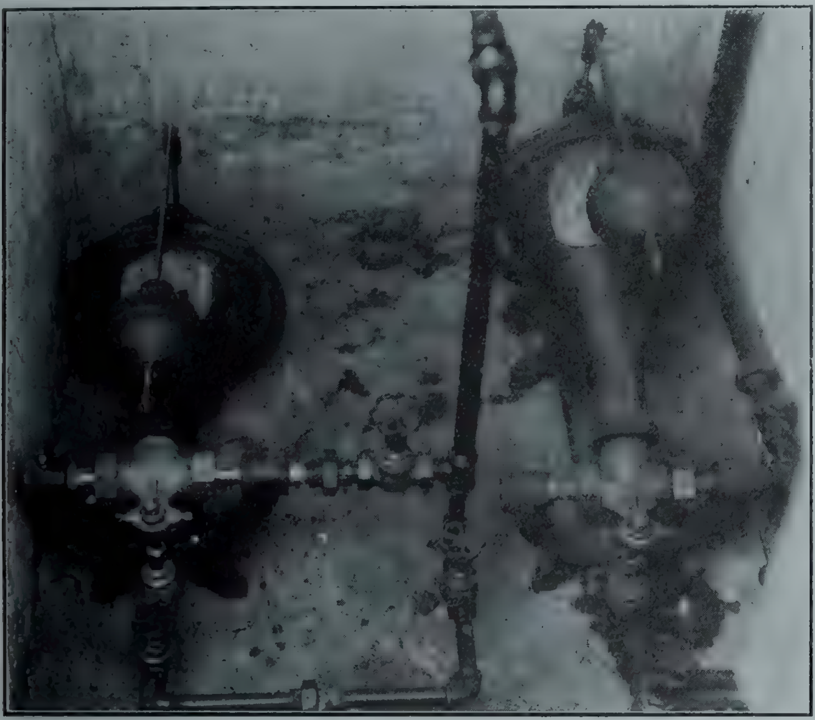


Fig. 4.—Typical Installation Bundy Tank Trap and Lifting Pump Trap in Pit Discharging Condensation from Fan Stack Coils. Planing Mill, Moncton.

Temperature is measured by expansion. As the temperature rises, the glass and mercury of a common thermometer expand, but as liquids are more expansible than solids, the mercury expands much more rapidly than the glass, and the apparent expansion of the mercury, shown by its rise in the tube, is the difference between the actual increase of volume of the mercury and that part of the glass vessel containing it. The thermometer, then, primarily indicates changes in volume; but as changes of volume in this case are caused by changes of temperature, it is commonly used for the more important purpose of measuring temperature. It is necessary for a thermometer scale to relate to some definite and unchangeable points of temperature. Nature furnishes two convenient standards. Ice, under ordinary atmospheric pressure, melts at the same temperature called the melting or freezing point.* Again, the temperature of steam rising from boiling water under the same pressure is always the same.

The freezing and boiling points are marked on the thermometers and the space between is divided into a convenient number of divisions. Two methods of divisions are adopted. In the Fahrenheit freezing point is 32 degrees and the boiling point 212 degrees, so that there are 180 equal divisions in between In the Centigrade thermometer there are one hundred equal divisions, freezing point being 0 degrees and boiling point 100 degrees on this thermometer. Temperatures below 0 degrees on both thermometers are marked by a minus sign. Thus —10 degrees F. is ten degrees below zero on a Fahrenheit thermometer or 42 degrees below freezing point.

Definite Relation.

There is a definite relation between the two thermometers. Since 100 deg. C=180 deg. F., 5 deg. C=9 deg. F. or 1 deg. C=9-5 of 1 deg. F. To obtain a Centigrade reading from a Fahrenheit first subtract 32 and then multiply by 5-9. Thus the following formula is the result:

$$C=\frac{5}{9}(F-32).$$

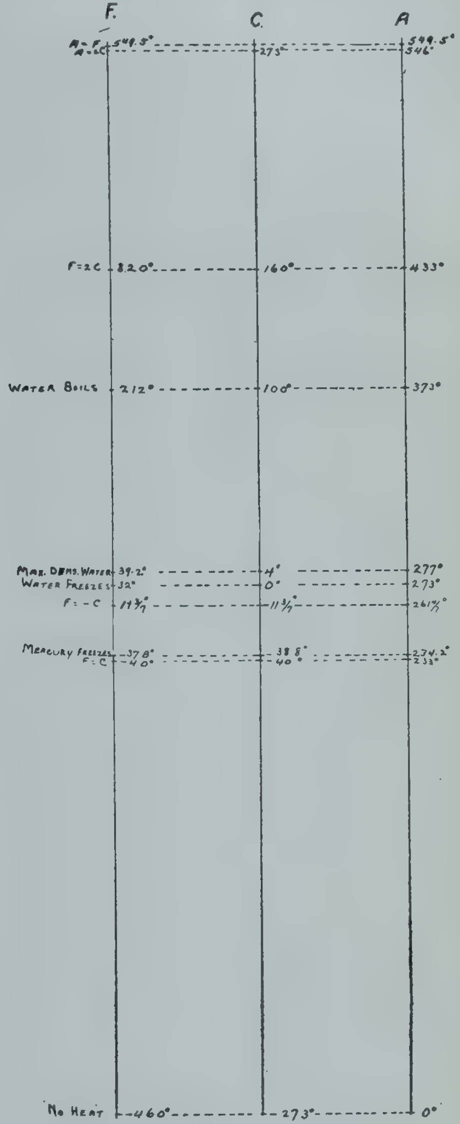


Fig. 1.—Temperature Comparisons.

To change a Centigrade reading to a Fahrenheit reading, first multiply the given number by 9-5, and then add 32. Thus:

$$F.=\frac{9}{5}C+32.$$

There is also a Reaumer thermometer and the relationship between the Fahrenheit and Reaumer readings are as follows:

R.=(F.—32).

$$F.=\frac{9}{4}R+32.$$

The Reaumer thermometer is not used in Canada, the Fahrenheit and Centigrade thermometer being the ones in general and scientific service.

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* Water freezes and ice melts at the same temperature.

Absolute Thermometer.

There is also the Absolute scale of temperature which is found by adding

To change Fahrenheit to Centigrade, the formula is reversed, thus:

A.=5-9 (F.+459 2-5).

The accompanying diagram shows some interesting relationships. At 549¼ deg. F. the Absolute reading is 549¼

COMPARISON OF TEMPERATURES.

Fahr.	Cent.	Fahr	Cent.	Fahr	Cent.	Fahr	Cent	Fahr	Cent.	Fahr	Cent.	Fahr	Cent.	Fahr	Cent.
0	−17·78°														
1	−17·22°	66	18·89°	131	55°	196	91·11°	261	127·22°	326	163·33°	391	199·44°	480	248·85°
2	−16·67°	67	19·44°	132	55·56°	197	91·67°	262	127·78°	327	163·89°	392	200°	485	251·65°
3	−16·11°	68	20°	133	56·11°	198	92·22°	263	128·33°	328	164·44°	393	200·56°	490	254·40°
4	−15·56°	69	20·56°	134	56·67°	199	92·78°	264	128·89°	329	165°	394	201·11°	495	257·20°
5	−15°	70	21·11°	135	57·22°	200	93·33°	265	129·44°	330	165·56°	395	201·67°	500	260°
6	−14·44°	71	21·67°	136	57·78°	201	93·89°	266	130°	331	166·11°	396	202·22°	505	262·75°
7	−13·89°	72	22·22°	137	58·33°	202	94·44°	267	130·56°	332	166·67°	397	202·78°	510	265·55°
8	−13·33°	73	22·78°	138	58·89°	203	95°	268	131·11°	333	167·22°	398	203·33°	515	268·30°
9	−12·78°	74	23·33°	139	59·44°	204	95·56°	269	131·67°	334	167·78°	399	203·89°	520	271·10°
10	−12·22°	75	23·89°	140	60°	205	96·11°	270	132·22°	335	168·33°	400	204·44°	525	273·85°
11	−11·67°	76	24·44°	141	60·56°	206	96·67°	271	132·78°	336	168·89°	401	205°	530	276·65°
12	−11·11°	77	25°	142	61·11°	207	97·22°	272	133·33°	337	169·44°	402	205·56°	535	279·40°
13	−10·56°	78	25·56°	143	61·67°	208	97·78°	273	133·89°	338	170°	403	206·11°	540	282·20°
14	−10°	79	26·11°	144	62·22°	209	98·33°	274	134·44°	339	170·56°	404	206·67°	545	285°
15	−9·44°	80	26·67°	145	62·78°	210	98·89°	275	135°	340	171·11°	405	207·22°	550	287·75°
16	−8·89°	81	27·22°	146	63·33°	211	99·44°	276	135·56°	341	171·67°	406	207·78°	555	290·55°
17	−8·33°	82	27·78°	147	63·89°	212	100°	277	136·11°	342	172·22°	407	208·33°	560	293·30°
18	−7·78°	83	28·33°	148	64·44°	213	101·56°	278	136·67°	343	172·78°	408	208·89°	565	296·10°
19	−7·22°	84	28·89°	149	65	214	101·11°	279	137·22°	344	173·33°	409	209·44°	570	298·85°
20	−6·67°	85	29·44	150	65·56°	215	101·67	280	137·78°	345	173·89°	410	210°	575	301·65
21	6·11°	86	30	151	66·11	216	102·22°	281	138·33°	346	174·44°	411	210·56°	580	304·40°
22	−5·56	87	30·56°	152	66·67	217	104·78°	282	138·89°	347	175°	412	211·11°	585	307·20°
23	−5	88	31·11°	153	67·22	218	103·33	283	139·44°	348	175·56°	413	211·67°	590	310°
24	−4·44°	89	31·67°	154	67·78°	219	103·89°	284	140°	349	176·11°	414	212·22°	595	312·75°
25	−3·89°	90	32·22°	155	68·33°	220	104·44°	285	140·56°	350	176·67°	415	212·78°	600	315·55°
26	−3·33°	91	32·78°	156	68·89°	221	105°	286	141·11°	351	177·22°	416	213·33°	605	318·30°
27	−2·78°	92	33·33°	157	69·44°	222	105·56°	287	141·67°	352	177·78°	417	213·89°	610	321·10°
28	−2·22°	93	33·89°	158	70°	223	106·11°	288	142·22	353	178·33°	418	214·44°	615	323·85°
29	−1·67°	94	34·44	159	70·56	224	106·67°	289	142·78	354	178·89°	419	215°	620	326·05
30	−1·11°	95	35°	160	71·11°	225	107·22°	290	143·33	355	179·44°	420	215·56°	625	329·40°
31	−0·56°	96	35·56°	161	71·67°	226	107·78°	291	143·89°	356	180	421	216·11°	630	332·20°
32	0	97	36·11°	162	72·22°	227	108·33°	292	144·44	357	180·56°	422	216·67°	635	335°
33	0·56°	98	36·67°	163	72·78°	228	108·89°	293	145°	358	181·11°	423	217·22°	640	337·75°
34	1·11°	99	37·22°	164	73·33°	229	109·44°	294	145·56	359	181·67°	424	217·78°	645	340·55°
35	1·67°	100	37·78°	165	73·89°	230	110	295	146·11	360	182·22°	425	218·33°	650	343·30°
36	2·22°	101	38·33°	166	74·44°	231	110·56°	296	146·67°	361	182·78°	426	218·89°	655	346·10°
37	2·78°	102	38·89°	167	75°	232	111·11°	297	147·22°	362	183·33°	427	219·44°	660	348·85°
38	3·33°	103	39·44°	168	75·56°	233	111·67°	298	147·78	363	183·89°	428	220°	665	351·65°
39	3·89°	104	40°	169	76·11°	234	112·22°	299	148·33°	364	184·44°	429	220·56°	670	354·40°
40	4·44°	105	40·56°	170	76·67°	235	112·78°	300	148·89	365	185°	430	221·11°	675	357·20°
41	5°	106	41·11°	171	77·22°	236	113·33°	301	149·44°	366	185·56°	431	221·67°	680	360°
42	5·56°	107	41·67°	172	77·78°	237	113·89°	302	150	367	186·11°	432	222·22°	685	362·75°
43	6·11°	108	42·22°	173	78·83°	238	114·44°	303	150·56°	368	186·67°	433	222·78°	690	365·55°
44	6·67°	109	42·78°	174	78·89°	239	115°	304	151·11°	369	187·22°	434	223·33°	695	368·30°
45	7·22°	110	43·33°	175	79·44°	240	115·56°	305	151·67	370	187·78°	435	223·89°	700	371·10°
46	7·78°	111	43·89°	176	80°	241	116·11°	306	152·22	371	188·33°	436	224·44°	705	373·85°
47	8·33°	112	44·44°	177	80·56°	242	116·67°	307	152·78°	372	188·89°	437	225°	710	376·65°
48	8·89°	113	45°	178	81·11°	243	117·22°	308	151·33°	373	189·44°	438	225·56°	715	379·40°
49	9·44°	114	45·56°	179	81·67°	244	117·78°	309	153·89	374	190°	439	226·11°	720	382·20
50	10°	115	46·11°	180	82·22°	245	118·33°	310	154·44°	375	190·56	440	226·67°	725	385°
51	10·56°	116	46·67°	181	82·78°	246	118·89°	311	155°	376	191·11°	441	227·22°	730	387·75°
52	11·11°	117	47·22°	182	83·33°	247	119·44°	312	155·56°	377	191·67°	442	227·78°	735	390·55°
53	11·67°	118	47·78°	183	83·89°	248	120°	313	156·11°	378	192·22°	443	228·33°	740	393·30°
54	12·22°	119	48·33°	184	84·44°	249	120·56°	314	156·67	379	192·78°	444	228·89°	745	396·10°
55	12·78°	120	48·89°	185	85°	250	121·11°	315	157·22	380	193·33°	445	229·44°	750	398·85°
56	13·33°	121	49·44°	186	85·56°	251	121·67°	316	157·78°	381	193·89°	446	230°	755	401·65°
57	13·89°	122	50°	187	86·11°	252	122·22°	317	158·33	382	194·44°	447	230·56°	760	404·40°
58	14·44°	123	50·56°	188	86·67°	253	122·78°	318	158·89°	383	195°	448	231·11°	765	407·20°
59	15°	124	51·11°	189	87·22°	254	123·33°	319	159·44°	384	195·56°	449	231·67°	770	410°
60	15·56°	125	51·67°	190	87·78°	255	123·89	320	160°	385	196·11°	450	232·22°	775	412·75°
61	16·11°	126	52·22°	191	88·33°	256	124·44	321	160·56°	386	196·67°	455	235°	780	415·55°
62	16·67°	127	52·78°	192	88·89°	257	125	322	161·11°	387	197·22°	460	237·75°	785	418·30°
63	17·22°	128	53·33°	193	89·44°	258	125·56°	323	161·67°	388	197·78°	465	240·55°	790	421·10°
64	17·78°	129	53·89°	194	90°	259	126·11°	324	162·22°	389	198·33°	470	243·30°	795	423·85°
65	18·33°	130	54·44°	195	90·56°	260	126·67°	325	162·78°	390	198·89°	475	246·10°	800	426·65°

Fig. 2.—Table of Temperature Comparisons.

273 to the Centigrade reading. The Absolute can be changed to the Fahrenheit scale directly. To do this the following formula is used:

F.=9-5 A—459 2-5.

deg.; at 320 deg. F., F.=C.×2 or C.=160 deg.; at 11 3-7 deg. F., C.=—11 3-7; and at —40 deg. F., C.=—40 deg. The accompanying table shows a comparison of degrees which may be used instead of using the formulae.

Experimental Determination of Boiler Horse Power

Some Considerations Entering into the Testing of a Steam Boiler by the Engineer to Ascertain if the Boiler is Carrying her Rating.

It quite frequently so happens that the horse power of a boiler is desired, to ascertain whether that boiler is doing its rated duty, and whether any means may be taken to improve the prevailing conditions. This is particularly true at the present time, when most factories are running at their limit, and when, as in many insatnces the boiler will not carry the desired load. Frequently the boiler is wrongly blamed for these conditions, where an intelligent test might prove that some other unit of the power plant was at fault. Every engineer, therefore, should know how to test his own plant to that end, so that the faulty unit may be found. Factory owners frequently will not increase their plants thinking that the existing plant may readily be forced to the desired capacity. An exact statement of the boiler performance by the engineer would inform him whether or not his supposition would hold good by apprising him whether the rated capacity was being exceeded or not. When an engine becomes overloaded, it is soon made appparent but this is not true with the boiler for as the general knowledge about boiler horse power is slight, no correct conjecture can be readily made to determine if it is the boiler at fault, or the engine, in requiring too much steam for the work.

To more completely understand the subject, the thermodynamic terms involved must be thoroughly understood.

The British Thermal Unit (B.t.u.), the fundamental heat-unit, is defined as the amount of heat required to raise a pound of water from 62 degrees to 63 degrees F.; but as the specific heat of water changes but slightly with the temperature, the B.t.u. may be said to be the amount of heat required to raise a pound of water between any two consecutive degrees, Fahrenheit. Therefore the heat absorbed by a pound of water in changing from 32 deg. F. to 212 deg. F. is 180 B.t.u.

The heat of the liquid (denoted by q), is the amount of heat required to raise a pound of water from 32 deg. F. to the boiling point corresponding to the temperature. This, as we have already seen, is 180 for atmospheric steam, increasing as the pressure rises.

The latent heat of evaporation (denoted by r), is the amount of heat required to completely evaporate a pound of water from, and at the boiling point. This for atmospheric steam means from and at 212 deg. F., and is 966.

The total heat of evaporation (denoted by H), is the sum of the heat of the liquid and the latent heat of evaporation, i.e., H—q+r, which in the case of atmospheric steam would be 180+966=1146, meaning that if a pound of water at 32 deg. F. were raised in temperature to 212 deg. F., and then completely evaporated, 1146 B.t.u.'s would be required.

The quality of steam (denoted by x), is the percentage of dry steam contained, expressed as a decimal. In explanation, steam carries away with it from the boiling water, particles of moisture, which make the steam "wet" in contradistinction to the state of the steam when it carries no water, when it is said to be "dry." With dry steam, x=1. If the steam contains 1 per cent. moisture, then x=99.

A clear understanding must be arrived at concerning the word horse power, as applied to an engine, and as applied to a boiler. An engine delivers work at a certain rate, which means power—hence horse power. Not so the boiler, it delivers heat, which does not mean a definite amount of work, and although delivering that heat at a uniform rate it does not actually mean power. In the engine horse power, the foot-pound is a perfectly definite amount of work, and the rate of expending those foot-pounds, 33,000 per minute means a horsepower; but with the boiler we are dealing with heat units directly. The relationship between heat and work, i.e., that 778 foot-pounds is equal to 1 B.t.u. and vice versa, is well known, and work may with facility be converted into that ratio of heat, but the reverse process is practically impossible, though theoretically not so. This means that while theoretically 1 B.t.u. equals 778 foot-pounds the conversion is for practical reasons an impossibility. The common steam engine exemplifies this, for different engines will yield varying amounts of work on equal quantities of the same steam under similar conditions though 1 to 778 is the ideal sought. Now, if this ratio were made use of to define horse power as applied to the boiler, owing to the fact that a good boiler absorbs the larger portion of the heat generated under it, while even the best engines convert but a small fraction of that heat, one can readily see that the horse power of a boiler would be several times greater than the horse power of the engine it would be supplying.

Realizing that this would be an undesirable means of rating, and also from the variety of classifications then extant, the American Society of Mechanical Engineers took up the matter, with the intention of forming a standard rating. Their committee, from numerous tests and enquiries, arrived at the conclusion that the average good engine used per horse power hour as much heat as would be required to completely evaporate 34.5 pounds of water from and at 212 deg. F. They therefore arbitrarily defined the boiler horse power as the amount of heat required to evaporate 34.5 pounds of water per hour from and at 212 deg. F. This shows that a boiler horse power is equal to 34.5× 966=33,320 B.t.u.'s per hour. In this sense, therefore, it is quite reasonable to consider heat as power, for it here implies the rate of doing work.

If a pound of water be forced into a boiler, and evaporated to quality x, its total heat will be $x_1 r_1 + q_1$, from which if the feed was above 32 deg. F., the heat of the liquid, q_2, of the feed, must be deducted to ascertain the actual heat imparted when converting into steam, which gives for this quantity $x_1 r_1 + q_1 - q_2$ B.t.u's. Under the conditions of the definition of the boiler horse power, the heat required per pound in 966 B.t.u. so that the ratio of the heat added in the actual case to that added as per definition, is

$$\frac{x_1 r_1 + q_1 - q_2}{966}$$

This fraction is called the factor of evaporation, and is defined as that quantity by which the actual evaporation per hour must be multiplied to determine the equivalent evaporation per hour from and at 212 deg. F., the conditions of our definition. This equivalent evaporation, if divided by 34.5 gives the boiler horse power.

Let w be the actual evaporation per hour; W, the corresponding equivalent evaporation per hour, and E, the factor of evaporation. Then

$$W = w \times \frac{x_1 r_1 + q_2 - q_2}{966}$$

$$= w \times E.$$

which gives

$$\text{Boiler horse power} = \frac{w \times E}{34.5}.$$

The accompanying table has been compiled with a view to the ready computation of boiler horse power problems, without recourse to a steam-table, which often proves confusing to one not conversant with their use. From the table, the factor of evaporation, E, may be read off for pressures every 20 pounds between 60 and 160, feed water temperatures every 30 degrees between 60 degrees and 210 degrees F., and for qualities of 1, .99 and .98, thereby covering most of the field. Intermediate conditions may readily be interpolated. For an example, consider a boiler carrying 120 pounds pressure, supplied with feed water at 150 degrees F., delivering steam with 1 per cent. moisture (x=99), and which generates 1,500 pounds of steam per hour under these conditions. From the table, E is found to be 1.101, which gives.

$$\text{Boiler horse power} = \frac{1{,}500 \times 1.101}{34.5} = 47.8.$$

Gauge Pressure.	Factor of Evaporation—E— When Feed Water Temperature Fahr. is						Quality
	60D.	90D.	120D.	150D.	180D.	210D.	
60	1.188	1.156	1.126	1.094	1.067	1.032	
80	1.193	1.162	1.131	1.100	1.070	1.038	
100	1.197	1.167	1.136	1.105	1.073	1.043	x= 1
120	1.202	1.171	1.140	1.109	1.077	1.047	
140	1.205	1.175	1.144	1.112	1.081	1.050	
160	1.208	1.178	1.147	1.115	1.084	1.053	
60	1.180	1.149	1.118	1.087	1.056	1.024	
80	1.186	1.154	1.123	1.092	1.062	1.030	
100	1.190	1.158	1.127	1.097	1.067	1.035	x=.99
120	1.194	1.162	1.132	1.101	1.070	1.039	
140	1.197	1.166	1.137	1.104	1.073	1.042	
160	1.200	1.169	1.140	1.107	1.076	1.044	
60	1.170	1.139	1.108	1.077	1.046	1.015	
80	1.175	1.144	1.113	1.082	1.051	1.020	
100	1.180	1.149	1.118	1.087	1.055	1.024	x=.98
120	1.184	1.153	1.122	1.091	1.059	1.028	
140	1.188	1.157	1.126	1.094	1.063	1.032	
160	1.191	1.160	1.129	1.098	1.067	1.035	

The factor of evaporation also proves useful in comparing boiler capacities, or the determination of how much a boiler capacity may be augmented by raising the boiler feed temperature. In the same example as before, with feed at 150 degrees F., E=1.101, while if feed water were delivered at 210 degrees F., then E=1.039. This means that the boiler capacity is increased by the ratio of $\frac{1.101}{1.039}$=1.059, which is a 5.9 per cent. improvement. A little consideration will prove the correctness of this, for, as the factor of evaporation is in a sense, a measure of the heat added per pound under the different conditions, being proportional to the heat, the smaller the factor of evaporation, the greater will be the capacity.

This foregoing would be of little practical value if the necessary observations could not be readily made. The feed water temperature, and the boiler pressure, requires no comment. To ascertain the quantity of steam generated, weigh the feed water by means of a tank, on a scale, from which the feed should be drawn intermittently, the quiet periods of the pumps being utilized to fill the tank, noting the weights when filled, and then when emptied. If two tanks be used, an intermittent operation of the pump is not essential. Various water meters are in use for the same purpose and prove very useful and convenient. The quality of the steam is a more difficult observation to make, and will of necessity have to be touched upon in a future article. It is sufficient to state here that 2 or 3 per cent. of moisture affect the factor of evaporation but slightly. It is quite safe to assume quality to be .98, using the table.

A Study in Heat Transmission to the Water in Tubes

Experiments Dealing with the Transmission of Heat to Water in the Tubes as Affected by the Velocity of the Water—Its Relation to Boiler Tubes.

By J. K. Clement * and C. M. Garland **

Experiments have been carried on at University of Illinois, Urbana, Engineering Experimental Station, with two objects in view; (1) to determine the effect of the velocity of the flow of the water on the heat transmitted through the walls of tubes; (2) to determine if the methods of experimentation used were applicable and desirable for a more extensive investigation of the subject, provided this seemed justifiable by the results obtained.

In the flow of heat from a medium, gaseous or liquid, in contact with a metal plate, there are three resistances to be overcome; the two film resistances, that is, the resistance between the liquid and the plate on each side, and the resistance due to the metal of the plate. In the case of liquids in contact with metal plates, it will be found that the first two resistances are considerable as compared with the resistance of the plate itself, and also that these film resistances depend upon the nature of the medium in contact with the plate, and the relative movement or agitation between the plate and the medium. Owing, therefore, to the multiplicity of media and to the state of these media, as found in practice, it was considered advisable to endeavor to determine the rate of flow (or transmission) of heat as a function of the three factors, temperature of tube, temperature of water and velocity of water.

Description of Apparatus.

The apparatus (Fig. 1) consisted of the steam jacket F provided with flanges and stuffing boxes at each end. The steam was admitted at C and bubbled up through the water in the jacket, which was kept at a constant level, and then passed out the exhaust at D. The pressure of the steam in the jacket, and therefore the temperature, was maintained constant by placing a safety valve on the exhaust pipe, and allowing the steam to blow through this valve throughout the tests. The bubbling of the steam through the water prevented the possibility of superheat due to throttling at the valve C.

The tube through which the flow of heat was measured was 1-in. Shelby cold-drawn steel tube, outside diameter 1.253 in.; inside diameter .985 in., and walls .134 in. thick. This tube was centred through the steam jacket, as shown, and packed around the ends. Each end was threaded, and a flange coupling used to connect the tube on the entering end with the water supply pipe A, and on the discharge end with the swinging ell at B. Rubber gaskets ¼-in. thick were placed between these couplings; on the discharge end, a sheet metal baffle was inserted. Another baffle was inserted in the pipe A about 18 in. above the tee. The object of these baffles was to break up the stream lines before reaching the thermometers T_1 and T_2. This was done in order that the average temperature of the water might be determined. The couplings were drawn together with insulated bolts. The insulation, together with the gaskets, was used to prevent the conduction of heat back on the tube. The water supply was taken from a constant tank head, located about 25 ft. above the tube, which permitted a maximum velocity of about 17 ft. per second. The velocity through the tube was regulated to suit the demands by means of a throttle valve placed in the pipe A. The steam supply was taken from the laboratory mains.

Measurement of Temperatures.

The temperature of the water, entering and leaving, was taken with mercury thermometers, reading directly to tenths; these readings could be estimated to hundredths of degrees C. The thermometers were passed through the stuffing boxes and were in direct contact with the water. The baffles, above mention, insured the breaking up of the stream lines, so that very nearly the average temperature of the water was obtained. This was tested by changing the position of the thermometers.

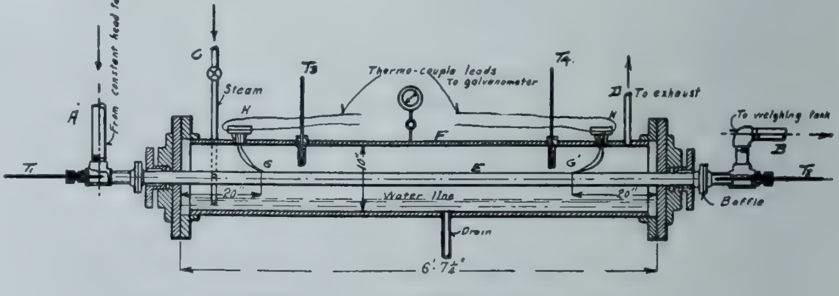

Fig. 1.—Transmission of Heat Through Boiler Tubes.

The temperature of the steam was also taken with mercury thermometers T_3 and T_4, passed through stuffing boxes, so that their bulbs were in direct contact with the steam. Allowance was made for the error due to the pressure of the steam on the bulb. The drawing shows these thermometers placed in thermometer cups; the cups, however, were taken out before the regular experiments were begun and replaced by stuffing boxes.

The temperature of the steam wall of the tube was taken by means of copper constan therocouples and a Siemens and Halske millivoltmeter. The couples were located at G and G', 20 in. from the face of each flange. The ends of the couples were soldered into small holes, about 1-32 in. in diameter, and about 1-64 in. deep, which were drilled in the surface of the tube. The leads were brought out through small glass tubing to the pipe flanges at HH, and then between two rubber gaskets placed between the flanges.

The mean temperature of the tube was taken as the average of the temperatures taken with the two couples, and is given in column 6 of Table 1. All readings were taken in Centigrade units and later changed to Fahrenheit.

Observations.

The velocity of the flow of the water through the tube was obtained by weighing the total amount discharged over a given period of time. This time was measured with a stop watch. In calculating the volume of water discharged, corrections were made for the different temperatures of this discharge.

Observations were taken over periods of from 3 to 12 minutes, depending upon the velocity of the water. During these periods, six readings of the thermometers were made, so that all of the temperatures given in Table 1 are the average of six readings. At the beginning of a period, an observer swung the end of the discharge pipe B over a tank previously balanced on a pair of platform scales, and at the same time

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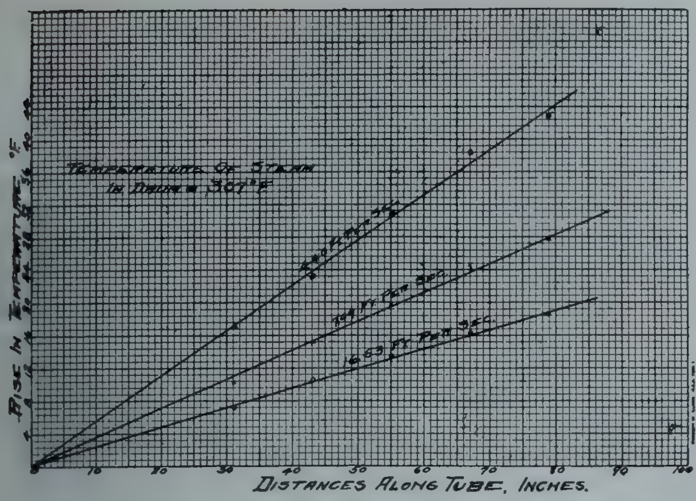


Fig. 2.

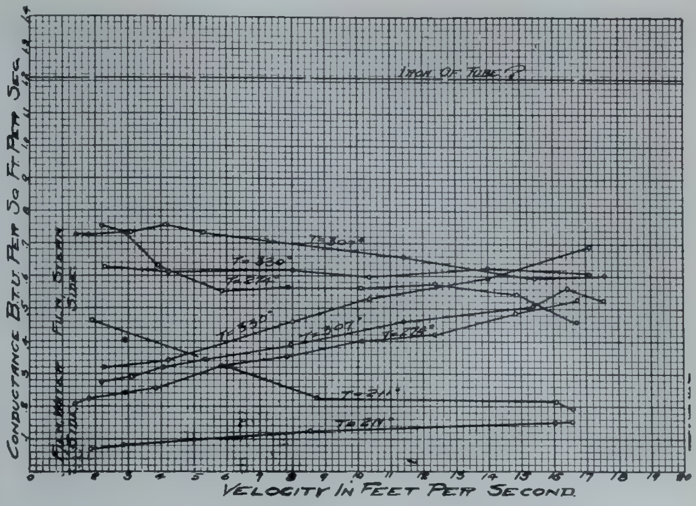


Fig. 3.

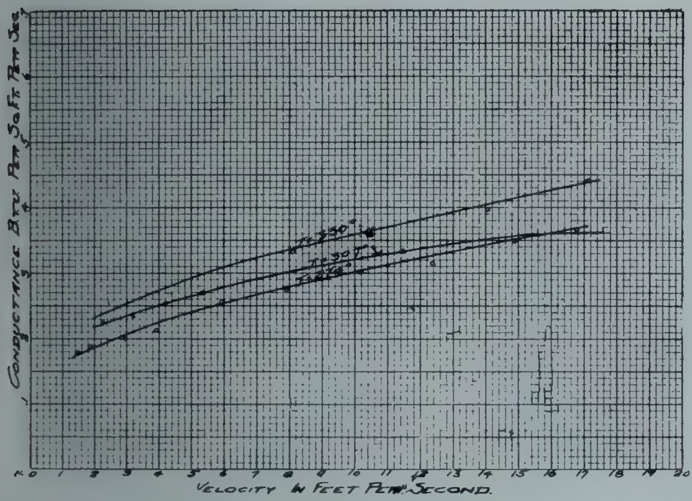


Fig. 4.

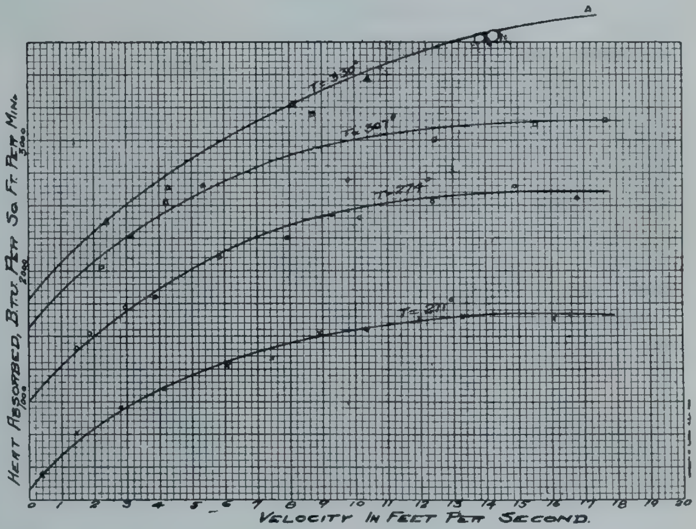


Fig. 5.

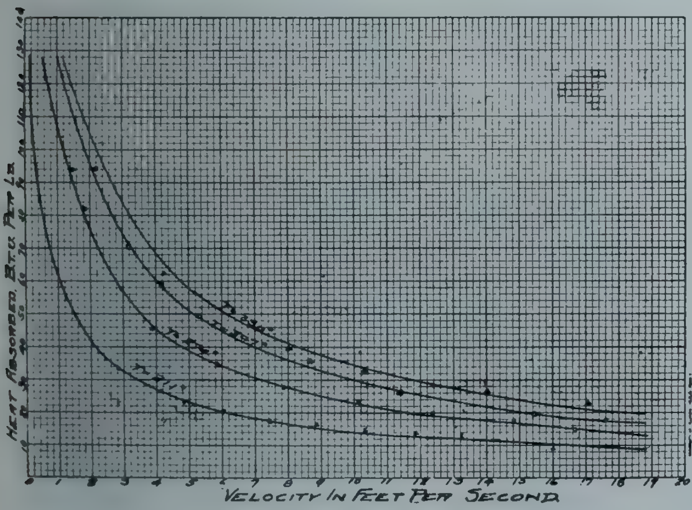


Fig. 6.

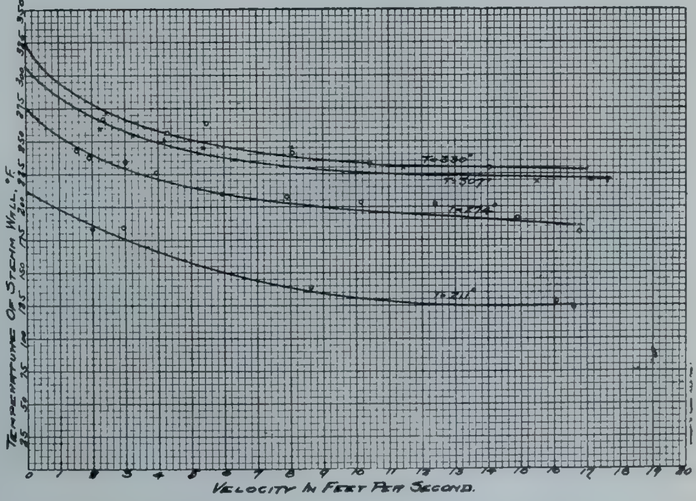


Fig. 7.

snapped the stop watch. The temperatures were then read at equal intervals during the period. At the end of the period, the pipe B was swung from over the water tank.

Observations were taken for four different temperatures of the steam in the jacket, 210.9 deg., 274 deg., 307 deg., and 330 deg. F., and for each jacket temperature the water velocity was varied from about .4 to 17 fet. per second. In these experiments, no attempt was made to keep the temperature difference consant between the steam in the jacket and the mean temperature of the water.

Calculations.

Referring to Table 1, column 14, the British thermal units per square foot per minute have been computed from the weight of water per minute, column 12; the rise in temperature of the water, column 4; and the area of the tube, computed from the mean diameter.

The mean temperature of the water, column 10, is the average of the items of collumns 2 and 3. The curves of Fig 2 show that within the temperature range of these experiments, this will be the true mean value.

The formula for the flow of heat through a given medium is similar to that for the flow of an electric current, and may be obtained as follows:

Let Q= B.t.u. flowing per square foot per second.

$(t-t_1)$=the temperature drop in degrees F. between two planes cutting the medium parallel to each other, and perpendicular to the direction of flow.

A=area in square feet of a section through which the heat is transmitted.

S=the time in seconds during which the flow takes place.

L=length in inches of the medium or the perpendicular distance between the two planes.

K=the conductivity of the medium, which is equal to the number of B.t.u. transmitted per second, per degree difference in temperature F., per square foot of area per inch of length.

$$\text{Then}\quad Q=\frac{(t-t_1)\times A\times S\times K}{L}\ldots(1)$$

The quantity K has been determined experimentally by a number of experimenters, and in c.g.s. units is about .2 for boiler iron. Reducing this to B.t.u., square feet, degrees F., and inches, we obtain the value, .1612=K=the conductivity of boiler iron. The reciprocal of the conductivity is equal to the specific

$$\text{resistance}=\frac{1.0}{.1612}=6.2.$$

In the present case the thickness of the wall of the tube is .134 in. The resistance of the metal of the tube per square foot, therefore, =6.2 x .134= .831 and the "conductance" is

$$\frac{1.0}{.831}=1.204.$$

This value has been assumed to be constant for the temperature here used.

It will be well to point out here the distinction between "conductivity" and "conductance," as used in the present article. Conductivity has been used to designate the quantity of heat which will flow through a medium of unit length and of unit area in a unit of time with a temperature drop of one degree, while "conductance" is independent of the length of the medium. The distinction is made necessary on account of the unknown thickness of the steam and water films.

The conductance of the water film, or the B.t.u. transmitted per square foot per second through this film may be determined in the following manner: Let

Q=B.t.u. transmitted per square foot per second.

A=area of the surface of the film in square feet.

S=time in seconds.

K''=conductance of the water film.

K''_1=conductivity of the water film.

L''=thickness of water film, and can not readily be determined.

$(t''-t''_1)$=drop in temperature between the inner or water surface of the tube and the water.

$$Q=\frac{K''_1\,(t''-t''_1)\times A\times S}{L''}\ldots(2)$$

and

$$K''=\frac{K''_1}{L''}=\frac{Q}{(t''-t''_1)\,A\times S}\ldots(3)$$

In order to determine $(t''-t''_1)$, it will be necessary to determine the temperature of the inner or water surface of the tube. The temperature of the steam surface is given in Table 1, column 6. From formula 1, having Q, which is obtained from Table 1, column 14, and K, given, the temperature drop through the metal of the tube may be computed. This has been done and the results are given in column 8. By subtracting the temperature drop through the metal of the tube from the temperature of the steam surface of the tube, the temperature of the water surface is obtained. This is given in column 9, and the drop from the water surface to the mean temperature of the water is given in column 11. Having this drop, the conductance of the water film may be computed from the formula.

A consideration of the phenomena occurring on the steam side of the tube is foreign to the purpose of this paper. As, however, the application of the results of experiments along this line have already proved of the greatest practical value in the design of high vacuum apparatus, and as our data are so closely related to this side of the problem, that is, the transmission of heat from the steam to the tube, it will probably not be amiss to devote a small amount of space to this phase of the subject.

On the steam side of the tube, if a condition of equilibrium is assumed to maintain, there will be the condition of saturated steam imparting its heat to a film of water on the surface of the tube, which film may be assumed to be of a constant thickness, and which is constantly being replaced or renewed by the condensation of fresh steam. The agitation of the steam in contact with the water film will, therefore, if it does not agitate this film, have no effect upon the rate of heat transmission or the conductance, at least, in the case of the present experiments; for the maximum velocity of approach of the steam towards the tube, due to the condensation, is about 1-5 ft. per second. This would lead one to believe that the temperature lead one to believe that the temperature on the surface of separation of the steam from the water film must be practically the temperature of the saturated steam. If such is the case, the agitation of the steam alone would not affect the conductance, as it would not change the temperature drop through the tube. The solution of the problem of more efficient heat transmission from steam to surface of tube, therefore, lies solely in the removal or agitation of the water film.

If it is then assumed that the temperature of the surface of the water film in contact with the steam is at the temperature of the steam, and that the temperature of the surface of the water film in contact with the tube is at the temperature of the tube, the conductance of the water film on the steam side of the tube may be computed from the following: Let

K'=conductance of the film.

K'_1=conductivity of the film.

L'=thickness of film in inches.

A=area of surface of film in square feet.

S=time in seconds.

Q=B.t.u. transmitted per square foot per second.

$(t'-t'_1)$=temperature drop between steam in jacket and outer surface of tube, as obtained by thermocouples.

$$Q=\frac{K'_1\,(t'-t'_1)\,A\times S}{L}\ldots(4)$$

therefore

$$K'=\frac{K'_1}{L'}=\frac{Q}{(t'-t'_1)\times A\times S}\ldots(5)$$

In the above formula A and S may be taken as unity; Q is obtained from Table 1, column 14; the values here given are expressed in B.t.u. per minute and must be reduced to B.t.u. per second before being used in the formula.

$(t'-t'_1)$ is taken from column 7 of the same table.

The value of L' cannot be determined.

The conductances of the water films on the stream and water sides of the tube are given in columns 15 and 16, respectively, and these results are shown plotted against the velocity in feet per second of the water in the tube, Fig. 3. The temperatures placed on these curves are the temperatures in the steam jacket during each experiment. The date from which the points on the 211 deg. curve were plotted were taken from the results of some later experiments, and have not been included in the table.

It will be seen from this figure, that the conductance of the film on the water side increases with the velocity of the flow of the water in the tube. This increased conductance at the higher velocities, which means a higher rate of agitation of the water, is due to the increased number of particles of the water coming in contact with the walls of the tube. The word "conductance" used to express the flow of heat from tube to water is somewhat inappropriate in this place, for it seems to suggest that the film remained the same so far as its physical structure was concerned, and that its heat conductively varied, while as a matter of fact, the increased flow of heat from the tube to the water at the higher velocities is due to the destruction or rather to the continuous renewal of this film. In the case of water flowing in a tube at velocities lower than the critical velocity, where the steam lines are parallel, we can consider that this stream of water is made up of concentric cylinders of water, the central cylinder of which is moving at the highest velocity, and the velocity of the outer cylinders gradually drops off until the lowest velocity is found in that cylinder which is in direct contact with the walls of the tube. In this case, the heat flow from the walls of the tube takes place principally by conduction, and the effect of convection is very small. The case is analogous to that of heating water in a vessel from the top, such as has been used for the determination of the specific conductivity of water and other liquids. When the critical velocity of the water in the tube is reached, or when baffles are placed so as to disturb the parallelism of the stream lines, the concentric cylinders of water disappear and the stream lines mingle and flow from side to side in zigzag fashion; the film of water adjoining the tube walls is being continually renewed by these zigzag stream lines, and the flow of heat from tube to water is carried on largely by convection.

The conductance of the film on the steam side has been computed and the results are given in column 15 of the table. These conductances have also been plotted against the velocity of flow of the water in the tube and are shown in Fig. 3.

It will be noted that the conductance of the steam film increases as the velocity of the water in the tube decreases. This is doubtless due to the decrease in temperature difference between the steam and the water as the velocity of the latter is decreased. This results in less condensation on the tube, consequently a thinner layer or water film on the surface of the tube, which makes a higher conductance possible.

(Continued in July Issue.)

WING TURBINE BLOWER INSTALLATION.

The accompanying illustration shows an instalation of the Wing Turbine Blower installed on internally fired or Lancashire type boilers, each of 100 h.p. carrying steam at 140 lbs. pressure, in the plant of the Consolidated Lithographing & Mfg. Co., Montreal.

The fact that these blowers were placed over the ash pit doors is particularly interesting, a steel casing of No. 12 gauge was made wide enough to cover the ash chamber and six inches deep, the depth not being enough to interfere with throwing in the coal, the casing has a sliding door which permits the ashes being removed. The casing is bolted on the front of the boiler with studs.

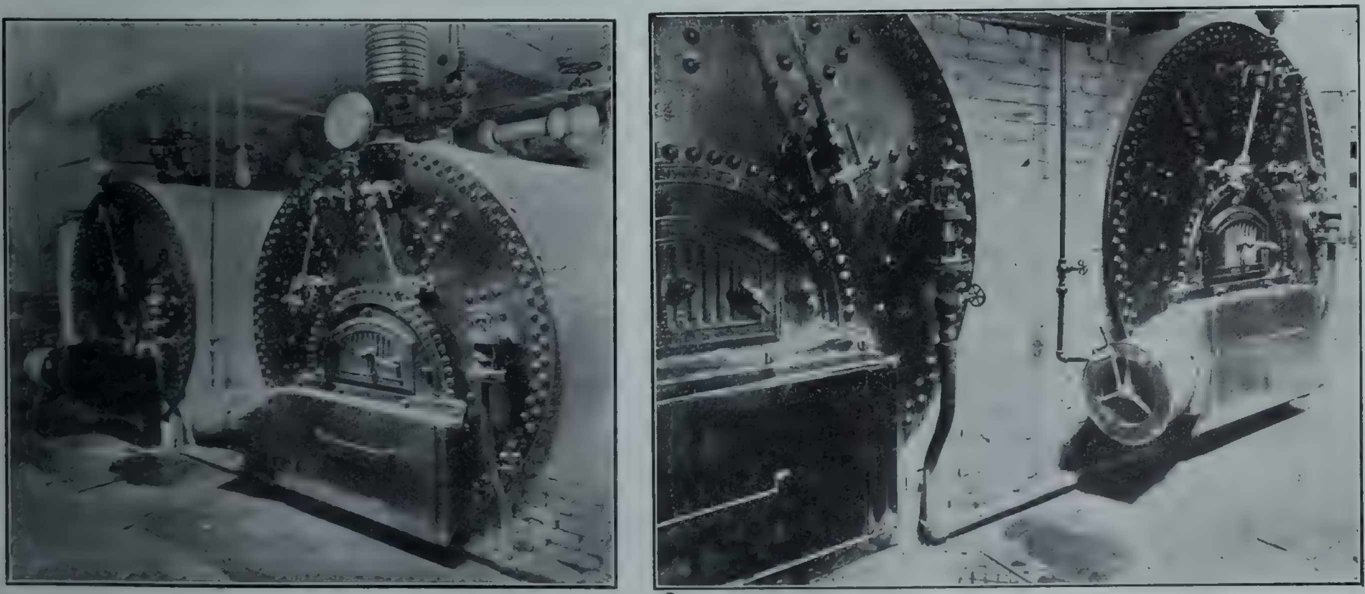
In this instalation 12 inch blowers are used, the boilers being 100 h.p. each, and the amount of coal used determining the size of blower required. The boilers burn pure anthracite, called "Bird's Eye," and one boiler will do the work formerly done by both; there is no clinker and the ash pit is cleaned once in twelve hours.

The saving effected was 19½ p.c., which paid for the instalation in four months. The Wing Turbine Blower consists of a special blade fan, with a series of buckets cast into a bronze ring on the outer edge of the blades of the fan, the steam is sent through three or more nozzles, from which the steam impinges on the turbine buckets which are designed to get a high value of steam expansion.

The amount of steam used is under 2½ p.c. of the horse power generated, this small amount of steam goes into the ashpit mixed with the air, this makes a moist air which to a great extent prevents clinkers and adds to the life of the grates; there is no vibration whatever, which, considering the spread of the blower, speaks for the perfect construction and perfect bearing. The Wing Turbine Blower for forced draft is made in four sizes, 12", 16", 20", 24" and for ventilatian purposes is made up to 48".

The blowers can be installed either in the side wall, back wall, front or to one side, a duct being used to convey the air; they require no space and with a pressure regulating valve or a damper regulator are entirely automatic, requiring no other care than oiling, which is done with a sight feed oil cup.

The instalation was made by Russel & Gifford, Montreal and Toronto, who are the Canadian manufacturers.



Installation of Wing Turbine Blowers in Plant of Consolidated Lithographing and Mfg. Co., Montreal, by Russel & Gifford.

A Study of Heat Insulation, Theory and Practice

The Article Deals with the History of Insulation, the Theory, Materials and Modern Practice of Insulation, giving Concrete Examples.

By L. O. HOOGE *

Perhaps the first people to realize the heat-nonconductive properties of different materials and reduce them to practice, were the Greeks. This ancient people built a fireless cooker, comprising a receptacle with well insulated bottom and sides, adapted to receive a cooking utensil and covered by a close fitting, well insulated lid. Food was raised to a cooking temperature and placed in the receptacle, whereupon the lid was immediately set in place, and as practically no heat could escape, the food cooked thoroughly and without danger of burning.

The red man had his ideas of insulation, and was correct in a way. We are all acquainted with his theory, viz., if a substance would keep out "cold," it would keep heat out, and his blanket was equally as useful in summer as in winter. Our modern ideas of keeping the body warm and cool conflict with the red man's, and the folly of his theory is obvious. However, his ideas when applied to pipe insulation is correct, and are the basis of the theory relating to insulation.

Briefly reviewing the laws of heat to refresh our memories, we find that there are three methods of transmitting heat, viz., conduction, convection and radiation.

Conduction of heat is best defined by an example: Heat applied to one end of a copper bar will be propagated through the bar, producing a rise in temperature which gradually travels to its most remote portions. In conduction of heat, each molecule imparts heat to its neighbor, which passes it to the next, until all the molecules have been heated. Obviously their temperature will not be the same, but will vary inversely as their distance from the source of heat, since some heat will be lost by radiation.

Convection of heat is its transmission between bodies by their repeated contacting with one another. Gases are heated by convection, the heated molecules of the gas contacting with the cooler ones, in this manner transmitting the heat throughout the whole substance. In fact, there must be a circulation in gases and liquids before they will heat thoroughly. This circulation may be caused by mechanical means or by the continued application of heat. Circulation in fluids, caused by heat, is due to the difference in weights of their unit volumes at different temperatures, causing the lighter ones to rise and the heavier ones to sink. Fluids in general transmit heat poorly, unless convection can be set up. If convection could be prevented, fluids would have no equal as insulators.

Radiation, the most difficult method of transmission to define, is one which is very important in the consideration of insulation, as the purpose of insulation is to prevent it. Radiant heat is that heat which leaves a body and travels in a straight line until intercepted or absorbed by some other body. It has the property of passing through some substances without affecting their temperatures, this property being known as diathermacy. It is not sensible heat until it is absorbed, whereupon the absorbing body's temperature is raised. A good example of this heat is that which is felt when warming by a stove or radiator. The amount of heat radiated depends upon the nature of the surface, and the amount exposed. A rough cast iron surface will radiate more heat than a smooth, glazed one.

Heat escapes from a pipe line by two different methods, namely, convection and radiation. If the air surrounding a pipe is still, very nearly all the heat is lost by radiation. If the air surrounding the pipe is moving, a large amount of the heat is lost by convection. The less convection that is set up about a pipe, the less heat is lost by the pipe.

Heat was at one time considered as an intangible, invisible fluid, that would flow through substance similar to a liquid flowing through a porous material. This theory was replaced by the modern one, which considers heat as a form of molecular motion. The comparative velocity of the molecules is determined by the thermometer, and when the motian is extremely great, high temperatures are registered, and when extremely sluggish, low temperatures are shown. When there is no motion, absolute zero is reached, and is estimated to be .460.7 deg. on the Fahrenheit scale. In discussing insulation, it is much better to consider heat as a form of energy, and it has been determined by actual experiment that one English heat unit, namely the British Thermal unit, is equivalent to 778 foot pounds of work; since 33,000 foot pounds of work performed per minute is equal to one horse power, 42.41 British thermal units are rquivalent to one horse power. Heat may be transformed into electrical or mechanical energy, or this energy may be transformed into heat and a reversible cycle is had.

Ordinarily, heat is generated by the combustion of fuel, and the true nature of combustion was not understood until after the discovery of oxygen, in 1775. From about the year 1650 until after this important discovery, the phlogistic theory was universally adopted. According to this view, a combustible was a substance, which contained, as one of its constituents, a substance termed "phlogiston," Easily combustible substances were considered to be rich in phlogiston, while those that were less inflammable were believed to contain but little of this ingredient. The act of combustion was regarded as the escape of phlogiston from the burning substance.

To-day, the theory of oxidation is universally accepted. Combustion is oxidation, and what is given off is heat. The amount of heat given off per pound of fuel is known as the calorific value of the fuel, and in English-speaking countries is given in B.t.u.'s per lb. of fuel. Every large distributor of fuel can give his customer the calorific value of the different grades, and knowing these values, it is possible to estimate the saving afforded by insulation.

Some substances are capable of absorbing more heat per unit weight per degree of rise in temperature than others, and the amount of heat absorbed under these conditions is known as the thermal capacity of the substance.

The specific heat of a substance is its thermal capacity compared with the thermal capacity of water, e.g., if the specific heat of a substance is .5, it requires one-half as much heat to raise a unit weight of it one degree, as is required to raise a unit weight of water one degree when the water is at the temperature it is densest. There are about six different thermal capacities, but the one just described is the only one we will have to deal with here.

The flow of heat is analogous to the flow of water, in that, as water always seeks its level, heat always seeks its temperature level. Heat invariably flows from a higher temperature potential to a lower temperature potential.

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* Insulation Manager of Philip Carey Co., 77 Front St. E., Toronto.

The quantity of it in equal weights of two different substances may be an identity, yet the temperatures may differ widely, and if the substances are caused to contact with one another, heat will flow from the one at the higher temperature to the one at the lower temperature until the temperatures become equal. The rate of the flow of heat between two different temperature levels depends upon the difference between the levels. The rate increases with the difference in temperatures, but the increment is a variable, and knowing the rate of flow between two substances at two certain temperatures, there is no method of calculating the rate between the identical substances at different temperatures. On account of this varying rate, the amount of heat radiated by a substance is different for each difference in temperature levels, and to determine radiation per degree difference in temperature and obtain absolutely correct results, is impossible.

Conductance of different materials varies with the temperature. A substance may be a fairly good insulator at a comparatively low temperature and when heated become a first-class conductor. However, very little is known concerning the conductance of heat at excessively high temperatures, and there will be ample time to discuss these features when the proper investigations have been made.

It is a law in chemistry that the thermal capacities of the atoms of all elements in the solid state are equal, in other words the specific heats of all the atoms are equal, It is obvious that the heat required to heat one atom one degree is the same that is required to heat any other atom one degree, when in the solid state, regardless of the substance. Atoms are constituents of molecules, which are the units "of the make-up" of the substance, and the thermal capacities of the molecules equal the sum of the atomic heats of the atoms which compose them.

Conduction is the heating of the molecules, and these heated molecules imparting their heat to those contiguous to them. Though the atomic heats of all solids are the same, the molecular heats vary, since their thermal capacities depend upon the sum of the atomic heats of their atoms, and all molecules are not composed of the same number of atoms. It seems that the ratio of the conductance of two different materials ought to be equal to the ratio of their molecular heats, but this is not the case, therefore conductance must depend on the construction or make-up of the material, as heat transmitted from molecule to molecule is affected by other influences other than the molecular heats.

These other influences, which are due to the construction, are taken advantage of in the making of pipe covering, and efficient insulation is manufactured. It is found that if minute air-spaces exist between the molecules of pipe covering materials, that the best efficiency is obtained, and that the smaller and more numerous they are, the higher the efficiency.

Heat is a form of energy, and loosely speaking, energy is capacity to do work, or in other words, its efficiency is lowered.

Insulation prevents the loss of a great amount of heat, and therefore increases the efficiency of the plant. The following is the amount of heat saved in per cent. by different coverings in comparison with bare pipe, when steam is at 100 lbs. gauge:

85 p.c. Magnesia	84.5 p.c.
Cork	84.2 p.c.
Asbestos Air Cell	82.1 p.c.
Remanit Silk, wrapped	88.8 p.c.

The first forms of insulation comprised a plastic cement, made of plaster of lime, or a product made from gypsum, talc, or other similar materials, all mixed with a certain amount of fibre. Constituents of composition of these different materials varied widely with different manufactures, but their shape and form were practically identical. They were molded into blocks, or sections so shaped as to conform to the surface to be insulated. It was less expensive than the insulation used at the present time, but its efficiency was much lower, yet it was not worthless and afforded a saving which was appreciable. Other insulation was used, such as mineral wool, asbestos paper, loose hair felt, live geese feathers, and even silk. Some of these substances, while excellent insulators, were too expensive for such rough work as pipe covering, and have been discarded on that account. Others were not durable or would not withstand the heat, but their combined qualities displayed their usefulness, and how essential insulation was in all power plant operation, whether it be advantageous to prevent the escape or the introduction of heat. Naturally, all effort was made to invent insulations that could be manufactured at a sufficiently low cost to be salable, and at the same time be adapted to the uses to which it was subjected. The result of all this effort is our present insulating materials—such as magnesia covering and cement, asbestos covering and cement, wool-felt, aircell, cork, etc.

Best Insulation.

The manufacture of insulation will require too much time to discuss thoroughly, and to the purchaser or engineer this is immaterial. It is more important to consider it in respect to its saving and use, and now we have come to these points.

The best insulation known is air confined in minute particles or cells, in such a manner that convection cannot be induced. No insulation can equal or excel that of perfectly still, stagnant air, and the value of most insulation depends upon the property of the substance to retain minute quantities of dead air, in which circulation cannot be set up. One author has enforced this idea so strongly that he has said that in general the efficiency of covering varies inversely as its weight—the lighter the covering the better its insulating qualities.

Prof. C. P. Gibson, determined from the numerous tests he has made, that the waste or loss in fuel alone, from uncovered pipes, under ordinary conditions, amounts to $64.50 per hundred lineal feet of pipe, coal being estimated at $4 per ton, and considering an average size pipe.

Results of tests published in column 23 of the Transactions of the Mechanical Engineers' Association, on one hundred lineal feet of two-inch pipe carrying a steam pressure of 80 lbs. gauge, shows a very high efficiency. Calculations based on data obtained in this test, on a plant working 300 days, at ten hours per day, with a temperature in the boiler room of 65 deg. Fahrenheit, and coal at $4 per ton, shows a loss of $31.04, or about 52c per sq. ft. per annum.

Concrete Example.

The price of fuel is not an important factor, as will be apparent from the following:

A large coal company in Pennsylvania was operating a battery of seventeen boilers. The president was consulted in regard to supplying the plant with insulation, but he argued that there would be no economy in such a move, as coal cost the plant only 40c. per ton or 7.00 a car. However, later he was induced to insulate his boilers and pipe system, whereupon the plant operated with 13 boilers more easily than it had formerly done with 17, saved a carload of coal per day, wages of the stokers, and wear and tear on machinery. To say that this operation displayed the merits of insulation to the satisfaction of the president, is superfluous.

Insulation Test.

In consideration of the great number of tests made by different engineers in different districts, the most reliable and extensive test ever made was that run by Prof. H. H. Stott. Briefly, the apparatus consisted of a pipe line comprising 200 lineal feet of two-inch pipe, mounted on wooden horses, and connected to the mains of a generator, adapted to cause varying large currents of electricity to flow through it and heat it to the desired temperatures. The results of this test were elaborately displayed by curves for each kind of covering having temperatures and corresponding pressures as valuation for their ordinates and British thermal units lost per square foot of pipe surface per minute for valuation of their abscissae. It was determined by this test that solid cork displayed a heat saving of 87.1 p.c. in comparison with bare pipe, and that 85 p.c. magnesia displayed a saving of 84.5 p.c.

In 1896 the American Society of Mechanical Engineers conducted a test at Syracuse, New York, between 85 p.c. magnesia and a covering composed of all asbestos fibre. Sixty feet of 8'' pipe was employed, and carried a steam pressure of 115 lbs. Magnesia saved about 4.5 p.c. more heat, or about $5.59 more per year than the other covering. The cost of magnesia covering was $33.87 applied, the asbestos cost $31.80 applied. In four and a half years magnesia would afford a saving over and above the other that would pay for itself.

The direct saving of fuel realized by insulation can be calculated from the data obtained by tests made on different insulations. Suppose the steam pressure to be 100 lbs. gauge and the insulation to be 85 p.c. magnesium carbonate. From tests we find that 1.76 B. t. u's are radiated per square foot of pipe per minute, when the pressure is 100 lbs. gauge and the insulation used is standard 85 p.c. magnesia, also that 84.5 p.c. of the heat is saved by this magnesia insulation. The fuel saved by insulation varies inversely as the efficiency of the boiler, or in other words, as the boiler efficiency decreases, the fuel saving increases.

Fuel Saved.

To determine the saving of fuel in pounds for a stipulated duration per square foot of pipe or other steam apparatus exposed, obtain the number of heat units saved in the given time, multiply this number by 100 divided by the efficiency of the boiler and divide the result by the calorific value of the fuel per pound, e.g., from our data at hand, we have

100 p.c.—84.5 p.c. equal 15.5 p.c.
15.5 p.c. equal 1.76 B.t.u.

84.5 p.c. x $\frac{1.76}{15.5}$ equal 9.59 B. t. u.

saved by the covering per square foot per minute.

Consider a year of 300 days at ten hours per day, then the saving in B. t. u.'s per square foot of exposed surface per year is 9.59 x 60 x 10 x 300, or 1,726,200 B. t. u's.

Assuming the calorific value of coal to be 12,000 B. t. u's. per lb. and the boiler efficiency to be 75 p.c., which are fair averages, the pounds of coal saved per year is

$\frac{1,726,200 \times 100}{12,000 \times 75}$ or 191.8 lbs. of coal saved per year per square foot of surface exposed.

If coal is $4.00 per ton there will be

$\frac{191.8 \times 400}{2,000}$ or 38c. saved per square foot.

Ten feet of 3'' pipe affords an external surface of 9.165 sq. ft. To cover 10 ft. of 3'' pipe with magnesia covering would display a saving of .38 x 9.165 or $3.48. Ten lineal feet of magnesia covering will cost the consumer 65 p.c. off list, or $1.58.

A year of 300 days will be considered to have months of $\frac{300}{12}$ or 25 days.

$\frac{1.58}{3.48}$ x 300 will give the number of days that will be required for the covering to pay for itself, or in round numbers, 136 days, $\frac{136}{25}$ or 5 months and eleven days

The above saving relates only to the direct saving afforded by insulation, and does not take into account other smaller savings that will be discussed hereinafter.

Selecting Coverings.

In selecting covering the two important factors to consider are the temperature to which it is to be subjected and its use. It may either be used to prevent the escape of heat or the introduction of heat.

Insulation for steam pipes, boilers, hot air ducts, hot gas conveyors, etc., come under the first class, while insulation for beer pipes, cold brine pipes, ammonia pipes, refrigerators, come under the second class. In general, the first class of insulation must not only be a good non-conductor of heat, but must be capable of withstanding the heat without losing its insulating qualities or becoming conflagrant. It must also be of such a composition that ordinary jars and vibrations will not cause it to crumble or break.

Insulation of the second class must be a good non-conductor of heat, and also impervious to water, whether the water in the form of vapor or a liquid. When water in any form comes in contact with a brine or ammonia pipe, it immediately freezes, and as there is always expansion accompanying freezing, the covering will be forced away from the pipe and broken. It has only been within recent years that really satisfactory insulation for this class of work has been made.

Cork and Air Chamber Covering are the principal coverings employed in the insulating of brine and ammonia pipes. These two, with wool felt in addition, are employed in covering cold water pipes.

It is evident that the heat lost by radiation or convection depends upon the area of the warm surface exposed, and when considering this fact in connection with insulation, it will be apparent that to increase the thickness of the insulation will also increase the amount of surface exposed, and facilitate radiation and convection to a certain extent. From tests run on covering of the same material subjected to a constant temperature, it has been revealed that within limits the efficiency increases rapidly at first as the covering becomes thicker, and after a certain thickness is reached, the increment of efficiency becomes less and less with further increase. The thickness that might be termed the "critical thickness" represents the best proportion between efficiency and thickness, and is practically equal to this dimension of standard covering. To apply insulation thicker than the standard, pays, as ordinarily manufactured, and if convenient, should be the practice. Standard covering ranges in thickness, for the smallest pipe up to a 12'' pipe, from 1'' to 1½'' thick. Covering of greater thickness, such as 1½'', 2'', 2½'' and 3'' is manufactured and carried in stock.

Underground conduit insulation has been a stumbling block for some time, but recently new forms of conduits have been placed on the market, and it will not be but a short while before the line will be perfected. Conduits heretofore have comprised a series of wooden boxes enclosing the pipe line, or a tunnel lined with brick or stone cemented over, and adapted to contain the pipes and their insulation. Pipe systems which employ the wooden box conduit are insulated by the box alone, a double box or by filling in around the pipe with loose saw-dust, mineral wool or substances of like properties. Insulation and conduits of this sort soon become almost as bad as none, since moisture will gradually find its way through the wooden casing and saturate the contents. The life of the wooden casing is short, and it is difficult to locate leaks in a pipe enclosed by it and insulated by some loose material.

Tunnels are the ideal conduits; the only objection to them is their cost. Leaks in pipes can be located easily, and the insulation is well protected from moisture and the earth.

Pipes that are exposed to the weather must have some protection for their insulation. This protection generally consists of a heavy jacket of tarred felt, well painted with some durable waterproof paint, or the insulation is covered with a specially prepared covering known to the trade as Argentum. Argentum is also used in a similar manner for underground insulation and is much better and longer lived than the wooden box conduit.

Most papers treating of insulation do not bring out every advantage available, or else they treat of its merits in such a smattering manner that their arguments are not impressive. It is the intention, in the conclusion of this paper, to make apparent every iota of merit, and discuss each thoroughly.

The advantages gained by the use of insulation may be divided into two classes, the direct, and indirect or remote advantages. Direct advantages may be considered as those which augment the efficiency of a plant directly, and might apply to the smallest, simplest type of heating plant, as well as a terminal station. The indirect advantages are those which are due to the insulation, but are only appreciated through operation of some apparatus other than the boiler and its furnace.

As was stated before, the amount of fuel saved by insulation is inversely proportionate to the efficiency of the boiler. In other words, if the boiler absorbs only 50 p.c. of the heat generated on the grate, and the remaining 50 p.c. escapes, partially by radiation and partially by way of the chimney in the hot gases, for every heat unit contained in the steam, two were expended by the fuel on the grate. It is obvious that under the above conditions if the insulation prevents the escaping of one heat unit per unit area of surface exposed, it actually saves an amount of fuel equivalent to two heat units, therefore, to obtain the fuel saved by direct heat loss of the pipe, the efficiency of the boiler must be considered as a factor in the calculation. The above is a direct advantage.

Another direct advantage is the prevention of the radiation of heat, thus providing a cool engine room. Also in buildings, in which pipes such as risers of heating systems pierce the rooms, it is oftentimes desirable to prevent the heating of perishable goods or furniture, which, if heated, would tend to cause the goods to spoil, or damage the furniture. When risers are too near the wall, insulation is sometimes applied to prevent the heat from the pipe, causing the wall paper to become loose and present an unsightly appearance.

The indirect or remote advantages afforded by insulation are generally not received with the appreciation due them. The following are some of the indirect advantages:

Fuel saved does not require handling, and a saving of power or labor is realized, according as to whether the stoking is performed by hand or machinery. If mechanical stokers are used, fuel is indirectly saved as less power is required to operate the device.

When insulation is applied, dryer steam is supplied the cylinders, and the steam consumption per horse power per hour is reduced. Dry steam gives a better expansion of the steam in the cylinder, as its properties approach more nearly the properties of a perfect gas, and naturally its expansion would follow more closely the expansion of this gas, thereby increasing the area of the indicator card, which means more power.

Also, less water of condensation collects on the cylinder walls, and logically, less heat of the steam need be expended to dry them. Another saving of steam. Since the steam consumption is reduced, obviously a saving of fuel is realized, for less steam must be generated by the boiler to produce the same power. It is apparent that the indirect saving is a wheel within a wheel, and that any saving effects the primary saving, namely, fuel reduction.

From different savings enumerated above, it is readily seen why the theoretical calculation, discussed in the afore part of the paper, shows a smaller economic value than the actual test run on a plant, for practically in the estimate only the direct saving was considered.

Other uses of insulation generally not considered, are the insulating of breeching, and the lining of smoke stacks, which aids in securing a good draft for the furnace and this provides for better combustion on the grate. If economizers are installed in the breeching, whose use is to aid in heating the feed water for the boilers, the efficiency of the plant is increased by insulating the breeching, as then the feed water is subjected to a higher temperature, as well as by aiding the draft. It is a well-known fact that the warmer the gases leaving a furnace the more rapidly they will ascend, and also that the density of the atmosphere varies with the distance from the earth becoming lighter as the distance increases. Keeping these facts in mind it is evident that to have a high velocity of the flow of the gases, the heat is more desirable higher up the stack than at its base, as the higher the light gas rises, the nearer and nearer the weight of a unit volume of it approaches a unit volume of the atmosphere. For this reason it is becoming more and more the custom to insulate the inside of stacks, especially those made of steel.

After the above facts have been considered thoroughly, no further argument need be submitted to prove the inestimable value of insulation. However, to construct apparatus that is absolutely heat-leak-tight is impossible, and in deciding upon what insulation to use, one should know about how much heat it will leak or what its efficiency is, based upon the heat lost by a bare pipe. And to every buyer the question "What insulation should I use?" presents itself. Certainty that depends on conditions, and these conditions differ widely, e.g., a steam pipe in a mine will not be covered similarly to a steam pipe in the engine room of a power plant. The best way to decide this point is to consult some engineer who has made insulation a specialty, and who is not only able to tell you without a reason which insulation is the best, but by exhibiting data from actual tests and by simple calculation prove to your satisfaction what insulation should be used. After such consultation it will be apparent that the advice given was to buy the best. And emphatically, and with the deepest sincerity, I will say—that in no other line should the axiom, "Remember the best is always the cheapest" be followed more rigidly than in the purchasing of insulation.

STEAM BOILER CONSTRUCTION.

"Be it resolved that this convention of the Associated Board of Trade of Western Canada, do respectfully draw the attention of the Dominion and Provincial Government to the hardship suffered by the manufacturers and others, owing to the existence of special separate steam boiler and boiler inspection and engineers' certificates, requirements for the different provinces, and urge the desirability of early legislation with a view to providing for a boiler construction and inspection requirement act of Dominion-wide application."

This resolution emanated from Brandon, and was moved by John Hanbury. The response that came from every part of the Board proved that the question was one of great significance to the country as a whole. One speaker stated that he purchased three boilers for Saskatchewan and wished to purchase more for Alberta of the same type, but the provincial regulations forbid him. He also pointed out that it was a severe hardship upon manufacturers to comply with the various provincial regulations and they were necessarily delayed in making satisfactory deliveries. It was carried heartily.

Darling Bros., Montreal and Toronto, have installed two Burnham pumps in the power plant of the Robt. Simpson Co., Toronto, in connection with the heating system for the large departmental store.

PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

BOILER FEED WATER PROBLEMS.

By R. McLaren.

In a recent letter I stated my intention of trying a mechanical boiler cleaner, and as I suggested that those who have tried them relate their experience, I feel in duty bound to give mine. First let me state the condition of the boiler—it was fairly clean. On opening it previous to the installation of the cleaner, there would be scale and mud at the rear end nearly up to the hand hole, and the mud would be about half an inch thick along the bottom and for some distance up the sides. At the front there would be a few pailfuls of scale and mud, and the tubes would be covered with a coating of light colored mud, which is familiar to those who use tri-sodium phosphate, which I use.

During the month that the cleaner was installed the boiler got its share of compound, the same as the rest, for otherwise I would have had to bolt it into the other boilers, and constant feeding is preferable. After running a month with the cleaner the boiler was opened, when we found that there was only about four double handfuls of clean scale at the front end and not a scrap of loose scale at the rear end, while the tubes appeared to be lightly dusted with the dissolved scale and will no doubt be that way until the scale is all dissolved or until I quit using the phosphate.

As a peculiar coincidence a compound agent happened to come in just after the boiler was opened. I showed him the inside of the boiler, front, top and rear, and, without saying a word about his errand he departed.

I am not finding fault with boiler compound, as that is something we must have as long as steam users can or will not see the benefit of clean boilers. They will pay a boiler maker's repair bill with a show of grace, but if the engineer suggests a mechanical cleaner they at once wonder how much graft there is in it for the latter, and turn it down, and continue paying for their boiler repairs and for excessive fuel bills. There may be materials in the feed water that will not precipitate readily by the action of the heat, such as the sulphates, in which case a small amount of compound is necessary.

Here is another case. In a plant which I visited recently I noticed that the vacuum pump on the heating system discharged into the bottom of the feed water heater, which was of the open exhaust steam type. Obtaining a thermometer the water was found to be at a temperature of 160 deg., although there was a surplus of exhaust steam. My suggestion was that the piping be so changed that the pump would discharge into the heater near the top. This was done and the temperature now is around 210 deg. The pump in my own plant was connected in the same way when I took charge of it, and perhaps some of you fellows are up against the same thing, and wondering why it is so hard to get steam.

Here is another problem. Did you ever consider the superiority of an open heater over a closed? One small advantage is the higher temperature obtainable for your feed water. An open heater easily gives 210 deg., while if you get 190 deg. with a closed heater you do well, and then it must be excessively large in order to keep this up. The difference between 210 and 190, i.e., 20, is equivalent to about 2 per cent. of your fuel bill. It is better than working your boilers hard, because by reducing their work more economical operation is obtainable.

Another advantage is the saving in boiler feed water and the consequent reduction of water bills, as well as the fact that the condensed steam is distilled water and contains no scale forming matter.

The quantity of water saved may be calculated in the following manner. Assume that the feed water enters the heater at a temperature of 50 deg. and is there raised to 210 deg., a rise of 160 deg. A lb. of steam at atmospheric pressure in condensing gives up 966 B.t.u., which is its latent heat. This is sufficient heat to raise

$$\frac{966}{160} \text{ equals 6 lbs. of water 160 deg.}$$

This gives us 7 lbs. of water for the boiler, 1-7 or about 14 per cent. of which being condensed steam. Suppose that your boiler is doing 100 horse power 10 hours per day for 300 days. Its total water consumption would be

$$\frac{100 \times 34\frac{1}{2} \times 10 \times 300}{10} \text{ equals 1,035,000 gal.}$$

At 8 cents per 1,000 gal. this would cost $82.80. A saving of 14 per cent. means about $11.60. As the water contains less scale forming matter, less compound is necessary, which is another item of saving.

BURSTING STRENGTH OF BOILER.

By O. P. St. John.*

The following question was recently asked me by an engineer, and thinking that it might be of interest to your readers, I will, with your kind permission, attempt to answer it through your columns.

The question was as follows: "The pressure of steam in the shell of a cylindrical boiler, being admittedly equal in every direction, why is it that in calculating the bursting strength of such a boiler, the diameter is used, instead of one-half of the circumference?"

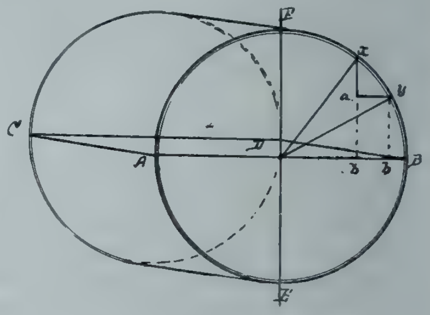

Fig 1.

It is true that the steam pressure is exerted equally in all directions, and at first sight it would appear as if the pressure was acting over the whole of the semi-circumference; and having a tendency to divide the shell in plane drawn through the diameter; that is that the steam was acting as a force to divide the shell in two semi-circles in the direction of its length, acting and reacting in opposite directions, and resisted by the strength of the material.

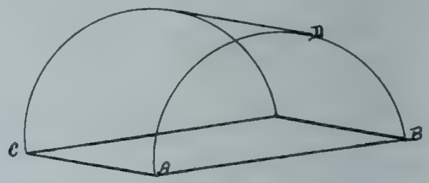

Fig. 2.

To Fairbairn, who was practically the original expounder of the true principles of boiler construction, we are indebted for much valuable information on this subject, and his demonstration when calculating the bursting pressure of cylinders, that the diameter, and not the semi-circumference should be taken, is the one usually found in our text books.

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* Boiler Inspector, Toronto.

In Fig. 1 consider first the pressure required to rend the shell through A B. The only points at which the force of the steam is exerted directly, are at E and F. As we leave this line on either side, the strain is exerted diagonally, and its direct lifting effect on the semi-circumference is correspondingly lessened, until at A and B it vanishes altogether.

In calculating the force required to burst any cylinder, or shell in this direction, the length is not taken into account, and the whole thing is simplified if we represent a portion of it by taking a ring 1 inch long, as it really makes no difference whether it be long or short, in respect to the pressure required to separate the two sides.

Referring to Fig. 1, let A, B, C, D represent the ring; P the pressure in pounds per square inch; x, y, a small portion of the circumference, and a, the angle x,y, makes with A, B.

Then the pressure upon xy, along the radius which passes through its centre, will be P multiplied by xy.

If we decompose this force, the vertical component will be represented by P, x, xy x cosine of the angle; but xy, x cosine of such angle, is always equal to the projection bb of the arc xy on the diameter A, B. The vertical component will then be equal to P, x, bb, and the sum of all the vertical components must of necessity, be P x A, B, the diameter of the circle.

To one having no knowledge of Trigonometry, this explanation will no doubt, appear very complicated, and formidable; but it resolves itself into a very simple rule, viz: That in all cases the force of steam tending to burst a cylindrical boiler, is always equal to the internal diameter of the shell in inches, multiplied by the gauge pressure in pounds per square inch.

To illustrate the correctness of this theory, let me show how absurd the opposite contention is.

Supposing Fig. 2, to be a semi-cylindrical vessel, of ample strength to withstand a pressure of 100 pounds per square inch, without distortion. We will assume the length of A, B, to be 42 inches and C, A, to be 30 inches. The length of the arc A, D, B, would then be

$$\frac{42 \text{ x } 3.1416}{2} \text{ equals } 65.97 \text{ in., say } 66 \text{ in.}$$

We will assume that the weight of the vessel is 1,000 pounds. Now supposing for the sake of argument, that the contention that the total pressure on the semi-circumference should be taken, instead of that on the diameter, let us see how it would work out.

Suppose that steam, compressed air, or other elastic gas, were introduced into the vessel to a pressure of 100 pounds per square inch. We would then have an upward pressure on the semi-circular top of 66" x 30" x 100 or 198,000 pounds, while to hold it down, we would have 42" x 30" x 100 pounds, or 126,000 pounds, plus the weight of the vessel, 1,000 pounds, or a total downward pressure of 127,000 pounds, which subtracted from 198,000 would give us a net lifting power of 71,000 pounds, and the problem of the man who tried to lift himself over a fence by the straps of his boots, would be solved.

Aerial navigation, under such circumstances, would be the simplest thing imaginable.

HOW TO SELECT A BOILER.

By Peter Bain, M.E.

Reasons of capacity and economy are the principal considerations which determine new boiler instalations. The evaporation of a given quantity of water into steam of a given pressure in a given time, is usually the object in view. If replacement of existing boilers is planned, a test of their evaporation in pounds of water per hour, of their evaporation per square foot of heating surface, and their evaporation per pound of fuel should be made.

If an entirely new plant is being installed, a guarantee can be had from the engine builders of the amount of water in the form of steam per indicated horse power per hour that the engine will use. In like manner, guarantees can be had from the makers of most other steam consuming apparatus which may form part of the instalation. As economical working of the boilers is the leading feature in most cases, the total heating surface should be such that the desired results are obtained without forcing, or allowing the gases to escape to the chimney at too high a temperature.

Assuming a working steam pressure of 100 pounds per square inch, and that 4 pounds of water evaporated per square foot of heating surface per hour is a satisfactory allowance and approved by good practice, it is only necessary to divide the required quantity of water to be evaporated per hour by 4, to arrive at the amount of heating surface the proposed boiler or boilers will contain.

Example—12,000 pounds of water to be evaporated per hour would mean

$$\frac{12,000}{4}$$

equals 3,000 sq. ft. of heating surface.

With average coal an evaporation of 8 lbs. of water from cold feed per lb. of fuel may be obtained; therefore 12,000 divided by 8 equals 1,500 lbs. of fuel to be burnt per hour. The problem is to select some boiler or boilers that will have a heating surface of 3,000 square feet; and here the more difficult and vexed question arises of choosing some type, and of dimensions to give the best heat efficiency.

To arrive at a correct conclusion, it is important that all the local conditions should be well and carefully considered. The following are the most important: Pressure of steam, kind of water to be used, space available, draught of chimney, facility of cleaning, whether the quantity of steam required is constant or likely to vary several times in an hour or day, whether it is important or not to abate smoke, kind of fuel to be used, its size, whether dust or large coal, much or little clinker, quality, smoky or not, and whether of high or low heating value.

In coming to a decision, the safety of the boiler should of course be the governing factor. It is well to consider the question of leaving room for additional boilers at a future time, and also space and provision for adding an economiser should it be afterwards necessary to force the boilers.

Advice on all these important points would be best sought from an independent authority, and by preference not a boiler maker. One type of boiler will generally give as good an efficiency as another, if properly worked, but much will depend uuon the load conditions. Internally fired boilers are preferred in some countries, but they are often so badly worked that they give worse results than boilers externally fired. The cost of the brick-work for the flues must be taken into account, also the foundations. If the soil is damp, care should be taken to avoid rusting of the plates, otherwise the safety of the boiler may be jeopardized, and lives sacrificed. The number of runs the hot gases are to take must be determined, and facilities given for cleaning the flues, and all internal parts of the boiler. If a Lancashire is chosen, the furnace tubes should not be too small in diameter. Boilers with smoke tubes generally give best results, as it is of the utmost importance for economy that the gases should not escape at too high a temperature. The volume of steam as well as water in the boiler should be carefully considered, and priming as far as possible avoided. A spare boiler in a factory is an advantage, as it affords an opportunity for cleaning one boiler at a time, while the others are at work. It may also be used to test different fuels, or burn rubbish. Other conditions being equal one large boiler is better than two small ones. If economy of construction is of much importance, 100 square feet of economiser surface costs much less than 100 square feet of boiler surface, but the former cannot be recommended for either hard or dirty water. The boiler should be so arranged that every square foor of heating surface, both inside and outside, can be seen, inspected and hammered. The safety of all boilers depends on careful inspection.

A new boiler should always be constructed to a good specification and under the inspection of a Boiler Insurance Company's engineer or other strict survey, and pieces of the steel plates used in its manufacture should be duly tested and reported on. Attention to these points is important to the life and safety of a boiler, and the small charge made by Boiler Insurance Companies for such valuable services, are paid for many times over. Their experience is very great in these practical details.

"Horse power" is a vague term for boilers and steam engines, and should always be avoided, if possible. A boiler should be made with so many square feet of heating surface, and not for so many "horse power."

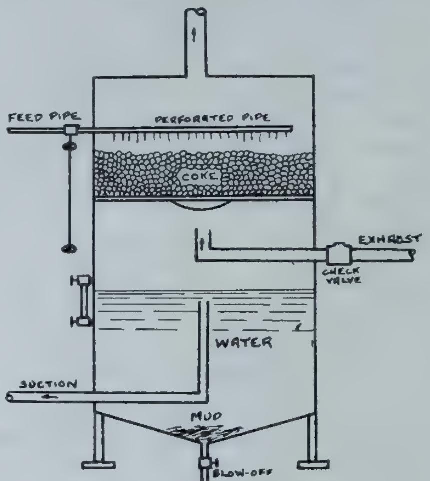
With proper care and inspection of every square foot of boiler surface, explosions from weakness, rusting or pitting, are nigh impossible. All boilers should be inspected, inside and outside, at least once every year. Boiler explosions are chiefly due to rusting, bad construction, or bad treatment. They are natural consequences, in nearly all cases, of defects which have not been seen, because they were not looked for. The actual condition of a boiler can only be ascertained from a thorough examination by a competent and well trained inspector. Every part should be looked at, as any part may be defective, and a water or steam test under pressure is not sufficient to ensure safety. To sacrifice quality of material or workmanship to a low-priced boiler is false economy.

More strict inquiry into the causes of boiler explosions and the location of the blame to the right person, would do much to increase knowledge of the various features of boiler construction, care and operation. It would impress steam users, and make them more keenly interested in this most important source of power supply. It would make these more directly concerned with the operative side, more careful and attentive, as well as prevent irresponsible persons from designing, building, setting, and inspecting boilers, of which their knowledge is so elementary, as to be a menace to public safety.

WATER HEATER.

By E. Keach.

The accompanying sketch of a heater is an idea of my own which I am building. The idea of the coke is to clean the water or act as a strainer and the exhaust steam entering underneath the coke, keeps the water at almost the boiling point. I am bringing the end of the suction pipe about 2 ft. up, on the inside of the heater. To allow the water to settle and the blow-off at the bottom to blow off the mud, I have a check valve near heater on exhaust feed line, so water can not back up on the engine. I think I can improve it by putting on a float so that the water feed will open and close automatically.



Coke Water Heater.

Correspondence

TRACTIVE POWER GEARS.

How do you find the tractive power of the different types of traction engines commonly used in Canada?

How do you find what sizes of gears to use for any power or speed required?

J. J. ANDERSON.

HEATING PISTON ROD.

I am in charge of a tandem compound engine. When it is running condensing with light load, piston rod has a tendency to warm up, but when running condensing, partly loaded it runs cool. It also runs cool at full load. When exhausting to atmosphere piston runs cool. Has anyone experienced the heating of piston rod as mentioned above?

SUBSCRIBER.

WATER SUPPLY SYSTEM TROUBLE.

The letter on page 58, May issue, on the above has been noted. If the three horse power motor operates the deep well pump and raises the relief valve and delivers water to the reservoir, it should also deliver water to the tank. If the 6" valve is closed, the 4" valve open, and the deep well pump continues to work and not deliver water to the reservoir or tank, something must be radically wrong. The water might be getting past the six inch valve and triplex pump if they are not in good condition, or there might be a leak in the six inch pipe which would allow the water from the small pump delivery to escape and not be noticed when the larger pump was working. With pumps having long suction and delivery pipes surging is often caused, that is the velocity of flow not only is not constant, but that the direction of flow reverses for a short period. Surging is generally most severe in the delivery pipe. Crank and flywheel pumps, owing to the variation in the piston speed between the beginning and end of the stroke, are particularly liable to cause surging, which is entirely due an irregular delivery. Air chambers do not help matters, but probably aggravate them by forming an elastic cushion for the column of water to rebound from. This only applies to cases with a very high delivery pipe for cases are on record where air chambers placed along a delivery pipe at intervals have helped considerably. Alleviators, which are not so elastic as air chambers are often used with success to relieve the shock caused by surging. Probably some of the troubles enumerated in the foregoing are the causes of the failure of the pump.

To estimate the vertical lift with a three horse power motor, multiply the horse power by 23,100 (which is 70 per cent. of 33,000, and allows for friction, etc.) and divide by the weight of water to be delivered per minute. Thus:

$$\text{Lift equals } \frac{23{,}100 \times 3}{\text{Weight.}}$$

Or

$$\text{Weight equals } \frac{23{,}100 \times 3}{100}$$

in this case where 100 is the lift in feet.

To find how much water the pump in question is delivering use the following formulas.

$$\frac{3^2 \times .7854 \times 16 \times 70}{231} \text{ equals U.S.gals.}$$

or

$$\frac{3^2 \times .7854 \times 16 \times 70}{277.27} \text{ equals imp. gals.}$$

JAMES B. NOBLE.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

CLAFLIN TUBE CLEANING APPARATUS.

A steam tube cleaner that involves many new and valuable features and known as the "Claflin" is meeting with considerable recognition in the United States, Canada and Mexico.

The practical construction of this appliance is illustrated by the accompanying cuts and among the points of greatest interest will be noted the following:

Fig. 1.—Shows the cleaner in its complete form ready for use. The dark shaded portions represent the parts of the cleaner as regularly furnished; the curved dotted lines merely represent a suitable length of steam hose attached and the dotted handle shows that it can be transposed from a horizontal to a 45 deg. angle connection, if desired, thus permitting the operator to reach much higher tubes without the use of a platform. The construction is entirely of metal, insuring strength and durability. The handle is tubular which makes it light, yet strong.

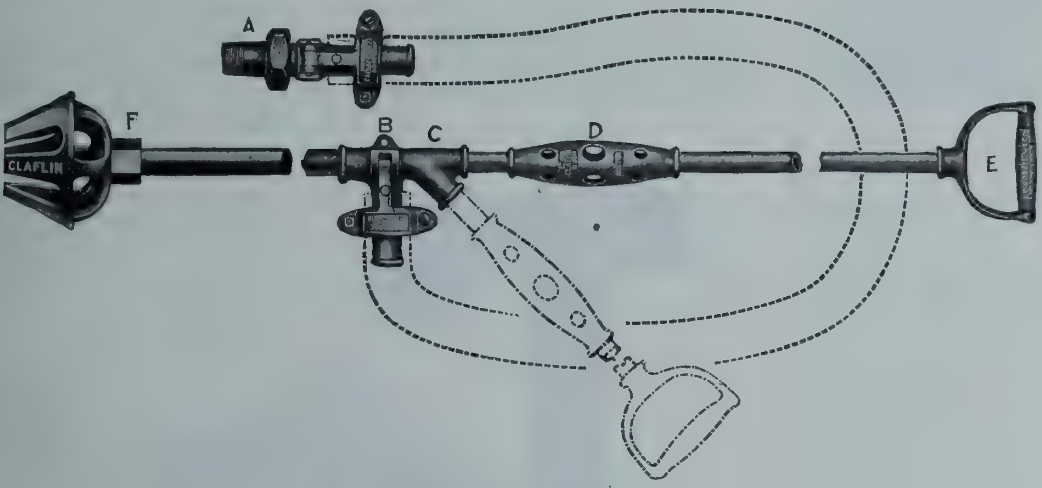


Fig. 1.—Claflin Cleaner Ready for Use.

The power of a steam tube cleaner (everything else being equal) depends upon the construction of the head. In this respect, the manufacturers of the "Claflin" cleaner claim their greatest stronghold, they being designers of the skeleton form of head, a sectional view of which is shown in operation in Fig. 2. Steam enters the head through a divergent tapered nozzle (as used in steam turbines, injectors, etc.,) and the nozzle is so proportioned to the steam supply and to the size of tubes to be cleaned, that it compels rapid longitudinal expansion of the steam in the direction of motion—through the tubes. At the same time, this steam imparts a terrific velocity to the great volume of air which it continually draws through the openings of the skeleton head. The socket-like contact of the conical shaped skeleton head against the end of tubes insures centralizing the swiftly moving steam and air current; the net result of this has a twofold effect, 1st, it balances the atmospheric pressure at both ends of tubes, because the influx of so much air destroys the vacuum that is naturally created as a sort of bi-product behind the discharge of steam, whereas ordinary tube cleaners that get little or no air relief create about 5 inches of vacuum behind the head with 80 pounds steam, under which conditions common tube cleaners cannot produce highest results.

Careful experiments have shown that not only is the velocity of the "Claflin" cleaner over $2\frac{1}{4}$ times greater than it would be without the use of the special nozzle and consequent induction of the great quantity of air, but that the combination of this mass of steam and air is so dense that it practically approaches a swab-like fit which dislodges every particle of soot in its path throughout the longest tubes.

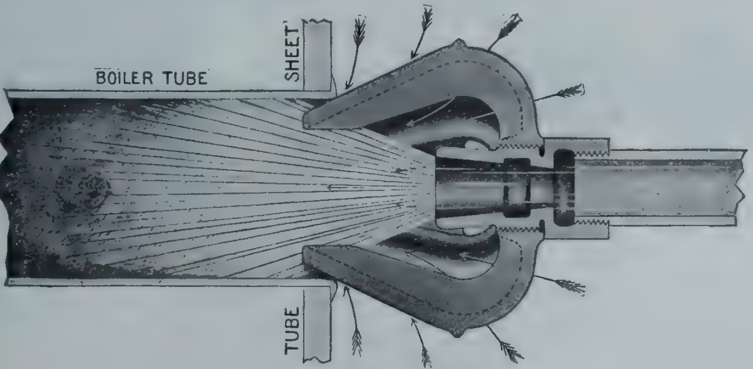


Fig. 2.—Skeleton Head in Operation.

Figs. 3 and 4—show the "Sure-Hold" steam hose fittings that are furnished (for both ends of hose) with each tube cleaner. The method of holding the hose securely can be seen by reference to letter A (Fig. 3) which represents a circumferential enlargement, forming an outwardly projecting convex rib, the purpose of which is to bulge that part of the hose immediately encircling the rib. B represents a concave recess formed on the inner surface of each clamp. When the clamps are brought together by means of bolts, these recesses not only surround the hose, but straddle the bulge created by the rib, thus producing an absolutely sure hold, hence the name "Sure-Hold." It is claimed that it is absolutely impossible to blow the hose off from one of these fittings, if properly attached, which is a very simple matter, therefore, any hose that can be attached to them will burst rather than blow off. It will also be seen by reference to the cuts that the form of these hose fittings is such that the hose cannot be injured by their use.

Again referring to Fig. 4, B shows an eye cast on the back of the special handle hose fitting, by which the complete cleaner and hose can be suspended when not in use, also affording means, if desired, for counterbalancing same when in use, through the mediumship of a suitable weight, cord and pulleys secured overhead

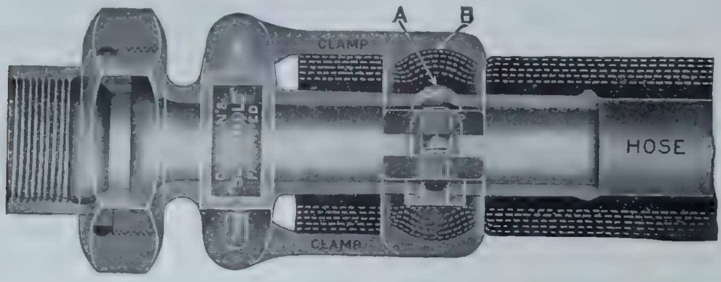


Fig. 3.—"Sure-Hold" Steam Hose Fittings.

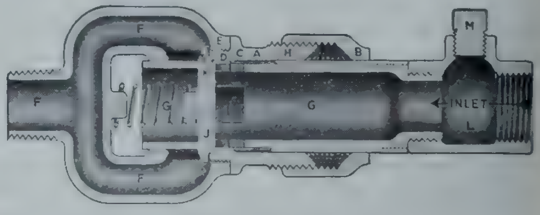


Fig. 5.—"Telescope" Balanced Steam Valve.

C shows the double tapping for the handle connection and also shows how the steam passage is cast independently of same.

Fig. 5.—Shows a sectional view of the "Telescope" balanced steam valve.

Fig. 6.—Shows its application to the "Claflin" cleaner.

By reference to the index letters of Fig. 5, it will be seen that A is a cylinder provided with a packing chamber B and differential shoulder C, valve seat D, discharge bonnet E—containing outlet ports F F F, and all adapted to practically enclose the sliding valve plunger G G, which is provided with a fixed differential sleeve H, four steam ports I I I I, valve disc J and valve-closing lip K ; L is a pipe tee fitted with plug M, which can be removed for instruction of lubricants.

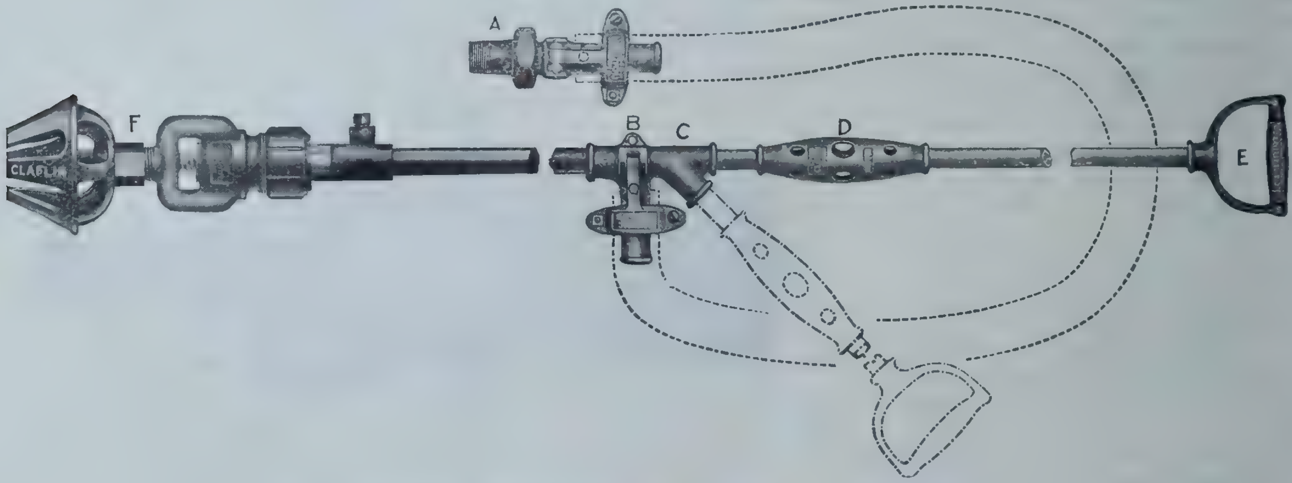


Fig. 6.—"Telescope" Balanced Steam Valve Attached to "Claflin" Cleaner.

The spiral spring holds the valve yieldingly against its seat and normally has ample tension to overcome the friction of the packing, holding the valve closed thus, also prevents possible injury thereto when not in use.

Its operation is as follows :—

Steam is admitted from boiler through supply valve and hose to the sliding valve plunger G G, where owing to the opposing effect of pressure on the acting areas of differential shoulder C and sleeve H, the valve J is held closed.

Steam pressure instantly balances and remains confined at steam ports I I I I, within a few inches from end of tube.

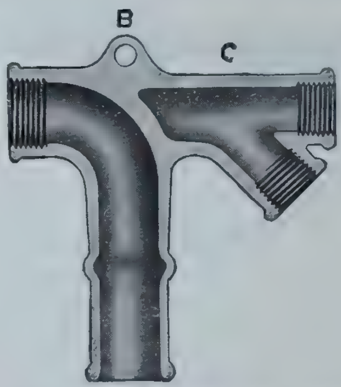


Fig. 4.—"Sure-Hold" Steam Hose Coupling.

A slight push on the tube cleaner handle is all that is necessary—through the telescopic effect—to lift the evenly balanced valve J wide open, allowing escape through steam ports I I I I, outlet ports, F F F, and thence through nozzle of the cleaner head and into tubes, thus producing a quick and powerful blow at full boiler pressure.

The flow of steam continues as long as cleaner head is held against end of tube, but upon relaxing the thrust on handle, as in moving cleaner head from one tube to another, the valve J automatically closes, because the open position of valve is such that interior surfaces of bonnet E and outlet ports F F F are exposed to steam pressure, in opposition to valve closing lip K, which tends to force them apart, or into closed position of valve.

The addition of the "Telescope" balanced valve makes the "Claflin" an automatic steam tube cleaner. The valve is made entirely independent of the cleaner and can be furnished complete with cleaner, or added afterward, in either event it is connected closely behind the head and does not interfere with the induction of air.

This apparatus together with other styles of tube cleaners, hose fittings and special braided steam hose, known as the "Vulcan" is manufactured by Chas. A. Claflin & Co., 600 High St., Boston, Mass., U.S.A.

MANUFACTURE OF STEEL.

On account of lack of space we were compelled to hold over an excellent article by Geo. D. Fowler, boiler inspector, London, on the manufacture of steel used in boilers. This will appear in the July issue and should be read with a great deal of interest.

Exhaust Steam; and Proper Feed Water Treatment

Utilization of Exhaust Steam and Treatment of Boiler Feed Water in Steam Power Plants---The Cochrane Heater and Softening System.

By N. K. Corderman.

It is a fact universally conceded that boiler feed water should be heated as near as possible to the boiling point before it is pumped into the boiler, in order that the tubes and plates of the boiler may be protected from expansion and contraction strains and in order that the purifying effect which is secured by pre-heating may be taken advantage of. Where the water is heated by means of exhaust steam there is the further valuable fuel economy arising from turning back into the boiler the heat represented by the exhaust steam.

As an example, suppose that a plant is using for boiler feeding water of an average temperature of 60 deg. F., and that there is enough exhaust steam available to bring this water up to 210 deg. F. The resulting saving in the coal bill will be about 15 p.c., since the heat of the exhaust steam takes the place of heat from the fuel, or with the same coal consumption as before, the boiler steam-making capacity can be increased one-sixth without handling more fuel or ashes, and without putting any greater heat transmitting duty upon the boiler heating surface.

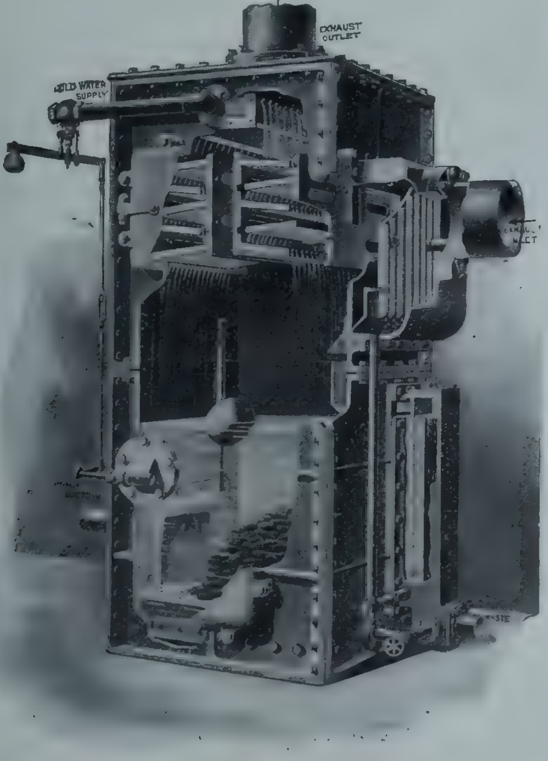


Fig. 1.—Interior View Cochrane Open Feed Water Heater.

In condensing plants, where the returns come back at 100 deg. F., says, the percentage saving of fuel is not so great, but still it will in every case pay to run enough auxiliaries non-condensing to obtain the amount of steam required for heating the feed water. Practically all the heat in the steam so used in returned to the boiler, and the efficiency of such steam operated auxiliaries is, therefore, greater than that of the main engine itself. At the same time, steam-operated pumps and stoker and fan engines, etc., are more convenient, more substantial, and less liable to stoppage than are electrically operated auxiliaries.

The use of exhaust steam for heating boiler feed water implies the following apparatus :

A feed water heater.

An oil separator to prevent the oil in the exhaust steam from entering the feed water heater, and

In most cases a hot well or returns tank for the reception of live steam drips, condensate and other returns suitable for boiler feeding.

All these appliances are included in the Cochrane open feed water heater illustrated herewith. The Cochrane oil separator, attached to and forming a part of the heater, removes the oil from the exhaust steam and the water heated by direct contact with the steam or the steam itself when condensed, can be used for boiler feeding and for other purposes, such as washing, dyeing, ice making, etc. Since the transmission of heat from the steam to the water is direct, the capacity of this apparatus is not affected by accumulations of scale forming matter, as long as it possible to pass the water through the heater. Further, the steam used in heating the water is condensed and added to it, diminishing the amount of raw or make-up water required. The latter is admitted by an automatic float and cold water valve in just sufficient amount to supplement the condensate, returns and condensed steam.

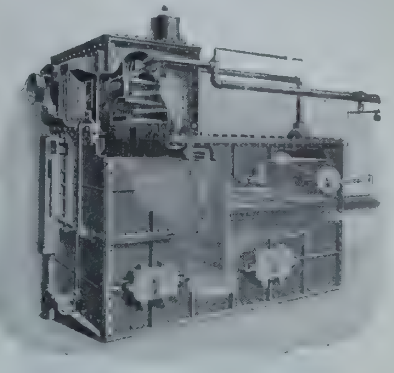


Fig. 2.—Hot Process Softening System.

Before passing to the pump supply pipe, the hot water stands for a time in a sedimentation chamber and then percolates through a filter. By raising the level of the water within the heater the surface can be caused to overflow, thereby removing floating impurities by skimming. The overflow, together with the drips from the oil separator, are passed to waster through a water seal, which prevents the escape of steam or the entrace of air to the heater.

The cold water is introduced into a water box in the top of the heater, from which it overflows upon removable cast iron trays. The heating of the water by spraying through the steam bath in this manner drives off air from solution in the water, which escapes through the vent. Recent investigations have shown that corrosion of boilers, piping, etc., is in a large measure due to the presence of air in solution in the water, and the driving off of the air is therefore of great benefit

At the same time, gases, particularly carbonic gas, both dissolved and in combination in bicarbonates of lime and magnesia, are driven out of solution. The breaking up of the bicarbonates results in their precipitation as normal carbonates. In this way, much of the scale-forming matter in the water is caused to be deposited in the heater; both on the trays and in the filter, saving the expense that would otherwise attend its removal from the boiler. In this way, waters, the chief impurities in which are carbonates or "temporary" hardness, as it is sometimes called, are quite satisfactorily softened by heating in the Cochrane open feed water heater.

However, if the water contains "permanent" hardness, that is, sulphates, chlorides, nitrates, etc., and free acids, some further treatment is required for their transformation. This is accomplished in the hot process system illustrated in Fig. 2, which is in reality an apparatus in which the functions of the Cochrane heater are extended to provide for the automatic introduction of a suitable softening reageant, and for the proper settlement and filtration of the water after treatment. The reagent usually employed is soda ash, which is automatically fed into the heater in accordance with the supply of raw water and the amount of substances requiring transformation contained therein. Due to the fact that the water is treated hot rather than cold, the reactions are much more quickly completed than in the ordinary cold process softening apparatus, and as the precipitated particles are larger, less time is required for sedimentation and filtration, so that the combined heater and softening system occupies much less space, and is much less cumbersom than a cold process softening system.

Further, the fact that the temporary hardness is corrected by heating obviates the necessity of using caustic lime or lime water, so that the soda ash is the only reagent remaining to be determined and fed. Aside from the saving effected in the cost of lime, this is most important from another standpoint, since where only one reagent is fed, it is a comparatively easy matter to determine its sufficiency, whereas with two reagents, a chemical analysis is required that can be made only by an expert. In other words, the hot process system, requiring the feeding of soda ash only, can be looked after by the usual boiler room attendants. Further, the hot process system, by combining the functions of an open feed water heater with those of a softener, greatly reduces the cost and complication of plant.

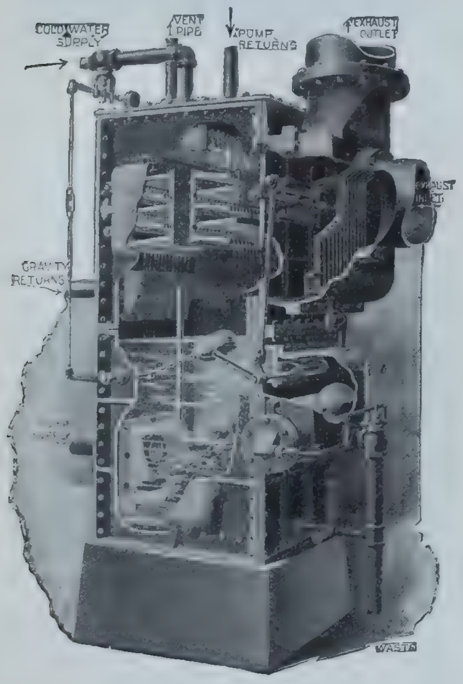


Fig. 3.—Cochrane Steamstack and Cut-Out Valve Heater and Receiver for Exhaust Steam Heating or Drying.

Still greater fuel economies than those outlined above are possible in plants where power production can be combined with heating or drying work. As is well known, by far the larger part, or some 80 per cent., of the total heat contained in the steam used in an engine or turbine is wasted to atmosphere or transferred to the cooling water in the condenser. If the engine exhausts against atmospheric pressure, the temperature of the steam leaving the engine is still as high as is required for heating purposes, that is, all of the heat remaining in the steam can be utilized for heating buildings, or in drying coils, calendering rolls, cooking kettles or other apparatus, and the prime mover abstracts from the steam only such amount of heat as is actually converted into mechanical energy or lost by radiation. Altogether, this will not amount to more than 20 or 25 per cent., so that where the steam is first passed through an engine or turbine, only one-quarter more coal will need to be burned than where live steam is used directly in a heating system, and at the same time the engine or turbine will generate as much power as it would if using the same amount of steam and exhausting to atmosphere, or one-half to two-thirds as much power as it would generate from the same steam when running condensing. Further, if the mechanical energy generated by the engine or turbine is used in the same building in which the heating is done, all of the heat of the exhaust steam will be useful in warming the building, so that we may say roughly that, as compared with running the engine non-condensing and using live steam for heating, the combined system shows an economy of 50 per cent., and as against live steam for heating and a condensing engine, there is a saving of 25 per cent. of the total fuel bill.

In order to use exhaust steam for heating or drying purposes successfully, arrangements must be made to remove all cylinder oil from the steam before it is passed to the heating system, and a hot well should be provided to collect the condensate or returns and to return them to the boiler. In this way, not only is a large saving effected in fuel, but also in water bills. The Cochrane steam-stack and cut-out valve heater and receiver, illustrated herewith, is a modification of the Cochrane heater previously described, especially designed for use in connection with exhaust steam heating and drying systems. The separator attached to and forming a part of the heater is of sufficient capacity to purify of oil all steam exhausted by the engines and auxiliaries, including the steam used in the heating or drying system, as well as that consumed in the heater itself. To make it possible to cut the body of the heater out of circuit for cleaning or inspection, while the heating system continues in operation, valves are incorporated between the separator and the body of the heater. Both valves are operated by a common valve gear, which on the larger sizes is so arranged that the smaller valve in the trap opens before and closes after the larger valve in the separator, thereby acting as a pilot valve, and relieving unbalanced steam pressure on the larger valve. The use of a steam trap, instead of the simple water seal found in the Cochrane open feed water heater, is required in order to carry such back pressures as may be involved in the operation of the heating or drying system.

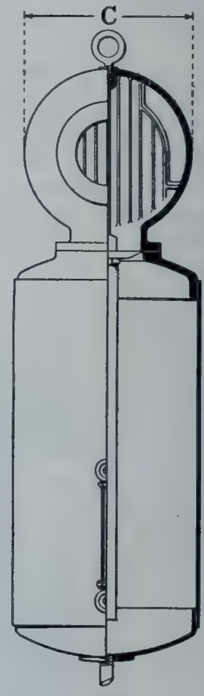


Fig. 4.—Receiver Separator for Horizontal Steam Pipe.

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IN NEW OFFICES.

The Power House is now located in the new offices of the MacLean Publishing Co., 111-127 University Ave. The printing plant is a model one, being up-to-date in every respect. The work of moving has been a big job, and as a result, the June issue is late. We are now in a better position than ever to handle the MacLean papers and in future readers may expect that The Power House will be mailed promptly on the 15th of the month.

◆

BOILER STAYS.

Flat surfaces in steam boilers must be braced or stayed in order that these surfaces may be able to withstand the force due to the pressure of steam that acts against them. Every engineer should know this fact. The tendency of the forces caused by the pressure within the boiler is to cause the boiler plate to become spherical in shape.

Knowing this, the article on "Staying a Locomotive Boiler," by F. C. Douglas Wilkes, in this issue, will be read with a great deal of interest. He shows that in this type (and it is applicable to other types where similar conditions exist) flat surfaces must be supported or braced against the force which tends to bend them. The article contains just enough mathematics to make the subject fully understood, is copiously illustrated and will make the subject of boiler stays clear to every engineer.

◆

ABOUT CATALOGUES.

Recently we received a letter from a subscriber in British Columbia regarding catalogues. He refers to certain manufacturers advertising in trade and technical publications that their catalogue will be sent forward if the request is written on the company's letter head.

The correspondent writes: "I find from experience that it is the working engineer who wants the information about the articles and how to operate them. Sometimes the catalogue is mailed inside the box with the article and is destroyed by grease and nails."

Catalogues should be widely distributed and both engineer and company supplied with a copy. Our correspondent in his letter writes: "The firms who print advertisements and catalogues and lock them up in the safe will find it mighty hard to get their wares to leave the warehouse. I am pleased to know there are some firms who agree with me and send engineers, the men who use the apparatus, particulars of their wares.

"I know several firms who send traveling engineers around to those establishments where their goods are used, to see that the engineer and fireman understand them. They see that the apparatus works properly, give instructions, catalogues, etc."

Our correspondent in attempting to hit one nail on the head has struck two nails squarely on their neads. The companies wish to get in touch with the engineer and the engineer wishes to procure literature in regard to power apparatus. For the information of the manufacturer with the catalogues we could read him the parable of the sower. Suffice it to say, however, that if the catalogues and information is not distributed, he will be the loser.

Then, again, there are engineers who do not avail themselves of the opportunity to procure information about apparatus on the market. In addition to reading carefully his technical paper, he should send for the catalogues that are procurable. A great number of companies, we are glad to say, will willingly send catalogues on request and engineers can become well informed on the various power rquipments on the market.

◆

BOILER EXPLOSIONS.

In the fifty-fifth annual report of the work and progress of the Manchester Steam Users' Association for the prevention of steam boiler explosions and for the attainment of economy in the application of steam, report 68 explosions during 1909, there being 22,334 boiler examinations by the inspectors of this association. This association inspects boilers, guarantees them against explosion, assists in keeping them clean and advises generally on matters efficent and economical working. This number of explosions is much less than in any previous year, in Great Britain, the number in 1908 being 73.

In United States the average number of boiler explosions reaches 350 per year. While the complete figures for Canada are not available, we feel sure in stating that the average in Canada is very high, certainly much higher than those for Great Britain. In United States there is a general agitation for better legislation. For some years the agitation has been carried on in Canada for legislation governing the construction, inspection and operation of boilers.

British Columbia was the first to undertake legislation and later Alberta followed. It was felt by the Canadian Manufacturers' Association, engineers and provincial authorities, that a uniform law would be in the interests of all concerned and, as a result of a recent conference, a uniform boiler law was drawn up and will be adopted by a number of the provinces. It is then hoped that the number of boiler explosions will be decreased. This will be one of the benefits.

Engineers can lower the number of boiler explosions by giving boilers under their care strict attention. Some time ago a representative of a Toronto engine and boiler manufacturing concern, visited a sawmill in the interests of his company. Coming to the boiler house he found the boiler in such a state that in less time than it takes to write this, he got as far away from the mill as possible. Afterwards, on enquiry, he found that the boiler had never been equipped with a safety valve; the pressure gauge had broken off and the pipe was closed up by plugging the pipe. In this issue is an article giving the engineer an idea of the enormous energy stored up within a boiler. If he will peruse it he will see that boilers are properly equipped with safety valves, pressure gauges, etc. By refusing to operate a boiler unless it is so equipped, proprietors will be compelled to guard against loss of life and property by supplying the necessary equipment.

Manufacturers and dealers in gun powder must build their factories and keep their supplies in a vicinity where a minimum amount of damage would be done in the event of an explosion. The greatest care is taken of a small quantity of gunpowder, but when the engineer realizes that every cubic foot of water within the boiler under his care, contains about as much potential energy as a pound of gunpowder, he may begin to realize that great care must be exercised in the discharge of his duty, and thus guard against boiler explosions.

◆

SUPERHEATED STEAM.

Of late years, competition has been very keen among engineers in the production of more efficient steam engines, modern business methods necessitating cheap power.

One of the methods to attain this end is the use of superheated steam, and when properly applied in engines specially designed—and even in engines not so designed—marked improvements are noticeable. This is particularly true on the continent, where most new plants have paid particular attention to this feature, the efficient degree of superheat appearing to be largely a matter of individual judgment of the engineers concerned.

The article on the specific heat of superheated steam, appearing in this issue, is particularly apt at the present time for the above reasons, especially as the little knowledge already accumulated on the subject does not appear to have been disseminated to any degree throughout Canada.

As pointed out in the article, there is a discrepancy between the results of Knoblanch and Jakob, and those obtained by Thomas. This may be accounted for to some extent by experimental errors, as each set of experiments was conducted with different apparatus, each having a certain degree of error, which the experiments eliminated to the best of their ability.

We hope our readers will pay particular attention to this, and any other articles appertaining to the subject, and that any information regarding the operation of such plants that come under their attention will be forwarded to us for publication to promote the present limited fund of knowledge.

◆

C.A.S.E. CONVENTION.

The C. A. S. E. convention at Berlin, July 26, 27 and 28, 1910, promises to be the most interesting gathering the stationary engineers have yet held, celebrating as it does the 21st convention. Victoria Hall will house the exhibits of the C.A.S.E. Exhibitors' Association, as well as provide rooms for the transaction of business.

A day is being set aside for the Exhibitors' Association, when all the visiting engineers will be their guests. Games and a supper will be provided for engineers and their wives and lady friends. The day will be concluded by a smoker, also provided by the Exhibitors' at which will be read papers by three men, prominent in the engineering profession, and to which all engineers are invited.

The reading of papers will add a great deal to the interest of the convention, and there will be a greater number of and more varied exhibits, so that every engineer, whether a delegate or not will find it to his advantage to attend the convention and exhibition for a day. The morning can be well spent studying the exhibits, games are provided for the afternoon and a smoker with papers for the evening. It will pay each engineer personally to attend. It will pay the employer to have his engineer attend. Excursion rates have been granted by the railroads. Detailed information will be given in the July issue of The Power House.

◆

REPAIRING BOILERS.

In this issue is an article on the use of the oxy-acetylene method in repairing boilers. Boilers sometimes give out in certain places and some method must be used at once to get the boiler back into commission. The increasing uses of oxy-acetylene has made it of use in the repairing of boilers. Repairing boilers is a difficult task and should be done by an expert.

There are several ways of treating a repair on a boiler. A slight bag in a boiler should be hammered into shape. This is often due to the accumulation of oil and scale allowing that part of a boiler to be overheated.

If it is necessary to put on a patch, the mechanic or engineer must be sure that he can get the patch within the boiler, this being the accepted practice though some boilermakers and engineers hold that it is immaterial whether the patch is put on the inside or outside. By putting it on the inside there is no recess in which residue can gather, thus making the old trouble possibe. Some boilers have no manhole below the tubes, hence when cutting out the defective part of the boiler sheet, the shape of the hole must be made such to allow the patch to be passed through, an oval shape must therefore be used.

Rivets and not patch bolts should be used in making repairs. The rivet heads exposed to the flames should be small. In calking a round nozed calking tool is used. The use of white lead, tar paper, etc., is prohibitive.

Always take the boiler inspector into your confidence when in trouble, and if repairs must be made, he will inform you of the best and most economical methods.

POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

British Columbia.

PRINCE RUPERT.—A big hydraulic plant is being installed on placer ground on the north fork of the Quesnel river, near Spanish creek, Cariboo district, by J. B. Hobson, the veteran mining editor of Victoria. He expects to have the plant going full blast long before the end of the season. The concession comprises about 240 acres. There is an excellent water supply. The ground is estimated to run five cents in gold per cubic yard. Ninety men will be employed. Mr. Hobson has been engaged in hydraulic and placer mining operations for forty-five years, twenty of which were spent in Cariboo district. On the old Cariboo concession he took out over $2,500,000 in bullion. His early mining experience was gained in California.

PRINCE RUPERT.—H. W. Dubois, of Philadelphia, is installing a $200,000 hydraulic plant on Twenty Mile creek, below the forks of Quesnel river. The plant will not be in shape to handle ground this season. The water will be conveyed to the concession in a fifteen mile ditch now being excavated.

KAMLOOPS, B.C.—The Imperial Power Co., of Vancouver, have located water powers on the Clearwater river, Raft river and Mad river, twenty-five hundred cubic feet in all.

Vancouver—Tenders for the construction of the new incinerator to be built near the end of Cambie Street bridge were considered. The Public Works Engineering Co., Portland, Ore., had four tenders for different types, ranging from $63,000 to approximately $70,000. Other tenders were: Dundon Excelsior Furnace Co., $69,000; Heenan & Froude, incinerator with front feed, $54,968; with back feed, $46,131; Dixon Engineering Co., $49,500; J. W. McFarlane, $82,357.

VANCOUVER—The Pacific Coast Pipe Co., of Vancouver, were awarded a contract for supply and laying in the municipality of Richmond about 72 miles of wire-wound wood pipes, as $69,931.86. Other bids were as follows: Municipal Construction Co., Vancouver, $76,670; Dominion Pipe Co., New Westminster, B.C., $78,624; Canadian Pipe Co., Vancouver, B.C., $80,500. The following tenders were received for 2½ miles of lap-welded 12-inch steel water pipe: Evans, Coleman & Evans, $16,745; Crane & Joy, $15,315, $17,087, $17,121; Robertson, Godson Co., $17,388, $17,121; 12-inch cast-iron pipe, A. C. Forsyth, $19,761. Cleveland & Cameron, of this city, are the consulting engineers.

VANCOUVER—The Pacific Province Power Co. have applied to the provincial authorities for extensive water rights on the Campbell river, Vancouver Island, for the purpose of installing a hydro-electric power plant.

VANCOUVER.—The contract for 5,000 feet of 2½-inch rubber-lined cotton hose for the fire department was divided as follows: 2000 ft. "Eureka' brand, at $1.25 per foot, to Vancouver Rubber Co.; 1,500 ft. Keystone brand, at $1.10 pet foot, to Canadian Rubber Co.; 1,500 ft. "Dunlop" brand, at $1.10 per foot, to Dunlop Tire and Rubber Goods Co.

SUNDERLAND.—The C.P.R. will erect cold storage plant, wharves, etc., at a cost of $38,000.

PRINCE RUPERT.—Blake Wilson, manager for P. Burns & Co., it is stated, has selected a site for a refrigerator plant at Prince Rupert.

PRINCE RUPERT.—A large fish handling and cold storage plant is to be erected here, building operations to begin in June. Plans for the work are being completed by Geo. L. Cjayton, consulting engineer, Seattle, Wash. The plans include installation of a 100-ton refrigerating plant, specifications for which are to be completed in about three months.

POINT GREY.—The council are considering projects for an appropriation of $500,000 to cover the cost of reservoir and site and the laying of mains. A by-law for $250,000 will also be introduced for sewage works.

VANCOUVER.—Smith & Sherborne, contractors, are erecting a five-storey building for the Vancouver Ice & Cold Storage Co., at Vancouver, at a cost of $60,000.

VANCOUVER.—The Canadian Woodpipe Co's tender of $16,397.50 for 17,000 feet of water main was accepted by the North Vancouver Board of Control.

Alberta.

CLARESHOLM.—The $15,000 waterworks by-law was carried.

CALGARY.—The city will probably establish an $80,000 power plant in Victoria Park. Plans are being prepared.

EDMONTON.—Tenders will be received until June 30th for plumbing, heating, ventilation and mechanical equipment required in connection with an asylum building. John Stocks, Deputy Minister of Public Works.

CALGARY.—Plans are being prepared for a power plant here. Estimated expenditure, $80,000.

Saskatchewan.

PORTAGE LA PRAIRIE.—The proposition ol C. Chamberlain, of the Great Fall Power Co. to furnish power to the city for a term of 30 years, was accepted.

SASKATOON.—A contract has been signed by the city with the Saskatoon Power Co., for the harnessing of the South Saskatchewan river, 14 miles below the city.

Manitoba.

WINNIPEG.—The Midland Railroad Co. will erect a row of warehouses for storage of fruits and produce along its Ross Avenue site to be used by fruit dealers and commission merchants The warehouses will be equipped with refrigerating plant.

DAUPHIN.—The $11,000 by-law for electric light purposes was carried.

Ontario.

PORT ARTHUR.—Recognizing the increase in shipping at the head of the Great Lakes, the Western Dry Dock & Shipbuilding Co. now have under construction a $1,250,000 dry dock and shipbuilding plant. This will be capable of handling the largest boats at present on the lakes, and the keels for two 600-foot freighters are expected to be laid as soon as the plant is far enough advanced for same. This work will entail a large amount of machinery, as there will be a complete boiler shop, rolling and punching shops, pattern shop and foundry. It will employ at least 500 hands when in complete operation. At the present moment about 200 men are on the ground on the construction work.

CARGILL.—The power house, pump house, cooper shop and heading mill of H. Cargill & Son were entirely destroyed by fire recently. The destruction of the pump house made the task of fighting the flames a hard one; four thousand empty barrels awaiting shipment were also destroyed. The loss will run up into thousands of dollars, partly covered by insurance. The firm will rebuild at once.

TILLSONBURG.—Fairchild & Webster, civil engineers, have opened an office in the Tillson block. Both members of the firm are engineers of experience and ability, being county engineers of Brant, Hadimand, and Norfolk.

WALLACEBURG.—The Empire Refining Co. are having their oil refinery equipped with a 15-ton refrigerating plant, furnished by the Carbondale Machine Co., Carbondale, Pa.

FORT WILLIAM.—The council awarded the contract for water pipe for city work to the Canada Iron Corporation, the price for the ordinary pipe is $33.75 per ton and for "specials" $60 per ton. The tender of the Kerr Engine Co. for hydrants and valves and of the Canadian Fairbanks Co. for two large hydrants were also accepted.

COLDWATER.—The citizens authorize the expenditure of $23,000 for the installation of a gravity system of waterworks.

TORONTO.—The Canadian National Carbon Co. will build a factory at Toronto, to cost $17,000.

INGERSOLL.—Two by-laws were voted on May 26, one to raise $39,000 to acquire the plant of the Ingersoll Electric Power & Light Co., and the other to raise $15,000 to make improvements and extensions to the plant, and were carried by large majorities.

BROCKVILLE—The commissioners have awarded tenders for two new steam engines and electrical equipment. Laurie & Lamb, of Montreal, were the successful tenderers for the steam engines, which are manufactured by Belliss & Morcom, of Birmingham, England. The figures for contract are $10,770.

WELLAND.—The Niagara, St. Catharines and Toronto Electric Railway are building a large brick transformer house to increase the power for their line. The branch to Port Colborne is nearly all graded, and will be in operation in a few months.

FERGUS.—Tenders will be received until June 22nd for the construction of 9 reinforced concrete bridges and culverts, and for abutments, steel deck and concrete floor on the Moorefield bridge. Bowman & Connor, 36 Toronto St., Toronto, county engineers.

WINGHAM.—Tenders, addressed to JOHN F. Graves, town clerk, will be received up to 6 p.m., 21st June, for the construction of Sewers and Sewage Disposal Works for the Town of Wingham. Plans and specifications may be seen and forms of tender obtained at the office of the undersigned or at the office of the engineers, Davis & Johnston, Berlin.

OAKVILLE.—This municipality have authorized T. A. Murray to prepare plans for sewerage disposal.

PETERBOROUGH.—The Board of Works authorized W. Chipman, C.E., Toronto, to prepare plans, etc., for the new pumping station and sewers, and to have tenders advertised.

Quebec.

TADOUSAC HARBOR.—Tenders will be received until June 29th for the construction of a wharf and approach. Address Department of Public Works, Ottawa.

MONTREAL.—Vickers, Son & Maxim, will build a floating dry dock at Montreal, near Longue Pointe. The dock will be completed in a year, will have a lifting capacity of 25,000 tons and will be capable of accommodating the largest of ships visiting the port.

GRANBY.—The Massachusetts Chemical Co., Walpole Shoe Supply Works and Walpole Varnish Works of Walpole, Mass., the Valveless Inner Tube Co. of New York, and the Walpole Rubber Co., of Granby, Que., have formed a merger under the title Walpole Rubber Co. All these companies have been doing business as independent enterprises, and it is expected that, by cutting expenses and co-operation incident to the merger, they will be more prosperous under a single management.

MONTREAL.—Board of Control recommended that the lowest tenderer be given the contract for cast iron pipe: The Stanton Iron Works Co., Nottingham, England, will be accepted for four and twelve-inch pipe, at $29.50 and $27.50 per ton respectively, while the tender of Robert McLaren & Co., a Scotch firm, will be accepted for 6, 8, 10, 16 and 20-inch pipe, at the following prices: 6-inch, $29; 8-inch, $27; 10-inch, $27.70; 16-inch, $27.35, 20-inch, $27.90. For the two largest sizes of mains, the 24 and 30-inch pipes, the lowest tender was submitted by the Canada Iron Corporation, of Three Rivers, at $27.50 and $27 respectively.

HULL.—The Waterous Engine Works Co., Brantford, will supply this city with a $5,300 300 fire engine.

MONTREAL.—Tenders for the supply of 10,000 tons of steam coal to be supplied the Lower Level pumping station of the Water Works were as follows: L. Cohen, $3.85; Geo. Hall Co., $4.05; J. O. Lebrecque, $3.85; W. Muir & Son, $3.68; Andrew Baile, $3.85. Messrs. Wm. Muir were awarded the contract.

QUEBEC.—The Harbor Commissioners have announced that their cold storage warehouse which was destroyed by fire recently, will not be rebuilt.

Nova Scotia.

LOCKPORT.—It is reported that the company which proposes to establish a cold storage plant at Lockport, as mentioned in previous issues of The Power House, will add a bait freezing department and keep on hand a supply of bait for fishermen at all times of the year.

LINGAN.—The Lingan Fish Co. has constructed a fish handling, cold storage and freezing plant, and will engage in handling both fresh and cured fish.

AGENTS WANTED.

ONE OF THE OLDEST European Companies manufacturing heavy electrical material, steam turbines, etc., employing over 5,000 men, and whose name, exceptional reputation and experience are known throughout the engineering circles of the world, is desirous of appointing representatives in British North America. It is considered that responsible agents with sound technical knowledge and used to big undertakings, can undoubtedly handle its leading lines with success, as the company is doing an important business in Great Britain and has already a number of important Canadian contracts in hand. Applications emanating from well-established engineering firms having branche offices in the different cities of Canada, will alone be considered. Replies to be addressed to Box 109, THE POWER HOUSE, Toronto, Canada.

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The Ackroyd-Buckley Patent Steam Superheater.
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New Brunswick.

MONCTON.—August F. Govang, of Moncton, was given a contract for 1,568 feet 18 x 12 pipe sewer and eight catch basins at $2,984.18. Other bids were: Amos Govang, Moncton, N.B., $3,430.10, manhole covers and catch basin traps; John Abrams & Sons, Moncton, $2.20 per 100 lbs. (this tender accepted); The Canada Iron Corporation, Limited, Londonderry, $2.45 per 100 lbs.; Record Foundry and Machine Co., Moncton, 2½ cts. per lb. and 3½ cts per lb.

New Canadian Agency.

An important Canadian agency, that of Clarke, Chapman & Co., Ltd., Gateshead, England, has been secured by the Linde British Refrigeration Co., Ltd., Montreal. These people have long been big suppliers to the British Admiralty and their products consist of ships auxiliary machinery, steam and electric winches, hydraulic machinery, pumps, boilers, engines, generating plants and electric locomotives.

This connection is a recent one and of no little importance to Canadian users of such lines as these. The Linde Company having now offices in Toronto, Winnipeg and Vancouver, besides their head office in Montreal are in a good position to handle the increased business resulting from such connection.

Located at Toronto.

Macdonald & Sons, Limited, have purchased the business of Bush & Macdonald, Montreal, and have transferred the business from Montreal to Toronto where splendid premises have been secured at 109 Church Street, just south of Queen. Besides controlling the sales of "Toledo" and "Jardine" pipe threading tools the firm have the Canadian agency for "Vosper" pipe cutters, and are also beginning the manufactore of "Positive" chain tongs. P. E. Macdonald, president of the company, will have charge of the Toronto offices, while his sons, C. C. and A. L., will push sales in the territory between Kingston and Port Arthur. A fine display room is being prepared on the ground floor of the new premises, the basement being used for manufacturing and storage purposes, and the second floor for offices.

BOOK REVIEWS.

STEAM.—Size 7 x10½ ins.; pages 202; numerous illustrations; bound in cloth. Issued by the Babcock and Wilcox Co., Montreal and Toronto.

It is the Seventh British edition of this useful book on steam, its generation and uses and it has been considerably enlarged and improved. The book deals with the theory of steam generation, circulation of water in boilers, steam boilers of the twentieth century, evolution of the B and W water tube boiler, complete description of the boiler, comparison between B and W and shell boilers, rules and practical data, fuels and furnaces, boilers in iron and steel works and in refuse destruction works, data on chimney stacks, properties of saturated steam, wet steam, superheated steam, economy of high pressure steam, heating feed water, incrustation and scale prevention of oil in boiler, central station heating, heating by steam, heating liquids and boiling by steam, drying by steam, flow of steam through pipes and orifices, equation of pipes, covering for boilers and steam pipes, care of boilers, testing boilers, and tests of B and W boilers. The foregoing shows that the subject of steam is very fully dealt with, and the book ought to be in the hands of every steam user.

CATALOGUES.

THE CANADIAN FAIRBANKS CO., MONTREAL AND TORONTO—Have just completed their general catalogue which will be ready for distribution July 1. The catalogue is a very artistic production and should prove of general interest to every manufacturer and purchasing agent throughout Canada. It is profusely illustrated and shows the many and varied lines handled by the company. The catalogue is divided into the following sections: Fairbanks scales, electrical apparatus and supplies, pumps, steam, belt, and gasoline, valves and steam goods, railway and contractors' supplies, small tools and supplies, power transmission appliances, safes, vaults, and metal office furniture.

In addition to the general catalogue, small sectional catalogue as listed above are being issued. The general catalogue consists of approximately 1,200 pages. A heavy coated paper is used in both the general and sectional catalogue, so that all engravings are shown up to best advantage. The general catalogue is bound in cloth covers, the sectionals in heavy cover stock, richly embossed. Neither expense nor time has been considered in preparing this catalogue, and it is with a great deal of satisfaction that we now present it for your consideration.

As a reference book it will prove of very great value in every manufacturing plant and a glance through its pages will bring to mind stronger than ever the position being filled by the Canadian Fairbanks Co., Ltd., as Canadian distributors. Copy of this catalogue will be mailed free to those who are interested in receiving it.

"ODESSE" DUPLEX STEAM PUMP.—The monthly folder of the Jno. Birch & Co., London, E.C., describes this, their latest development in steam pumps. The pump is well described and a good cross-sectional view shown, as well as a conveniently arranged table of different sized pumps and their capacities, with their prices attached.

GENUINE DETROIT LUBRICATORS.—The Detroit Laibricator Company, Detroit, Mich., have issued their 14 page condensed catalogue of Detroit Light Feed Lubricators, which briefly describes the various types made by them, giving details as to price, etc. It forms a neat reference book for an engineer to have, and forms a condensed edition of their fuller catalogues.

ANNOUNCEMENT.—Dearborn Drug and Chemical Works, Chicago, Ill., have issued an announcement of their removal to newer and more commodious quarters in the McCormick Building, Michigan Ave. and Van Buren Street, Chicago. This is where their offices and chemical department are to be in the future with their factory as formerly on Thirty-Fifth Street. In their new quarters they hope to renew old acquaintances and obtain new ones, in their work of improving boiler water conditions.

UNDERFEED STOKERS.—The American Ship Windless Company, Providence, R.I., have issued a 24 page booklet entitled "Results from Tests of Boilers Equipped with Taylor Gravity Underfeed Stokers." It gives several complete tests conducted by different consulting engineers and plant owners of boilers equipped with this stoker in different parts of the country. The tests appear to have been very carefully conducted, and every detail considered, so that the results would seem to be worthy of careful study. The results tend to bear out the contention of the company that their stoker economises in every way.

SMOOTH-ON INSTRUCTION BOOK.—The Smooth Mfg. Co., Jersey City, N.J., has just issued the 9th edition of this booklet, which now contains 96 pages. It tells all about Smooth-On Iron Cements, Sheet Packings, Corrugated Metal Gaskets, and shows when, where and how to use them. The book is unique, in that along with every use cited, it gives an actual illustrated application, as well as many letters of recommendation. It shows where Smooth-On Iron Cement has united broken valve joints, pumps, repaired flanged joints, stopped leaky seams in tanks, boats, and caissons and numerous instances of repairing cylinders are cited. In addition the method of carrying out the repair is shown. Leaky pipes appear to be readily fixed with the Smooth-On Elastic cement. Other instances too numerous to mention are given. It is an admirable little book for the purpose.

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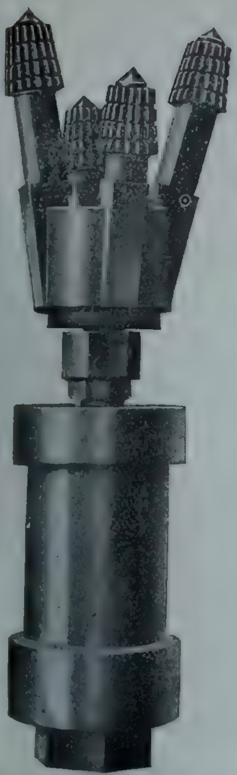

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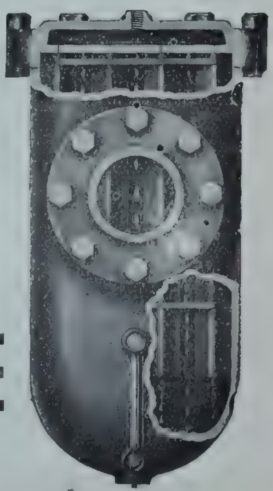

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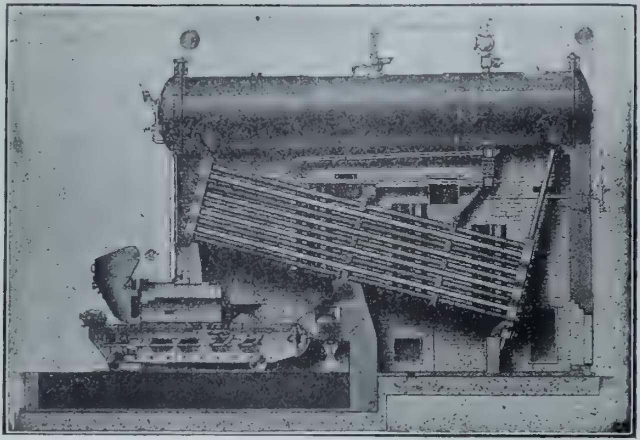

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Power Economy Co., Montreal

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Canadian Fairbanks Co., Ltd., Montreal
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D. K. McLaren, Ltd., Montreal.
Sadler & Haworth, Montreal.

Bending, Pipe.

National Pipe Bending Co., New Haven, Conn.

Blowers.

Canadian Fairbanks Co., Ltd., Montreal
Power Economy Co., Montreal
Matthews & Yates, Manchester
Russell & Gifford, Toronto
Turbo-Blower Co., New York

Boiler Compounds.

Canadian Oil Companies, Toronto
Dearborn Drug and Chemical Works, Chicago, Ill.
Electric Boiler Compound Co., Guelph, Ont.
Hygienic Laboratories, Toronto
International Boiler Compound Company, Chicago
Geo. W. Lord Co., Philadelphia
Nichols Chemical Co., Montreal
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Boiler Compound Feeders.

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Hygienic Laboratories, Toronto
Michigan Lubricator Co., Detroit
Morehead Mfg. Co., Detroit, Mich.

Boiler Feed Pumps.

Canadian Fairbanks Co., Ltd., Montreal
Canadian Steam Boiler Equipment Co. Toronto
Darling Bros., Montreal

Boiler Feed Regulators.

Automatic Feed and Regulator Co., London
Bain & Mitchell, Montreal
Canadian Fairbanks Co., Ltd., Montreal
Peiler & MacKenzie, Montreal
Power Economy Co., Montreal
Standard Engineering Co., Toronto.

Boiler Feed Water Regulators.

Canadian Fairbanks Co., Ltd., Montreal
Power Economy Co., Montreal

Boiler Mountings.

Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal
Darling Bros., Montreal
The John Inglis Co., Ltd., Toronto
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
Peiler & MacKenzie, Montreal
Standard Engineering Co., Toronto.

Boiler Settings.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Boiler Tube Cleaners.

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The Paul B. Huyette Co., Philadelphia.
Liberty Mfg. Co., Pittsburg
Michigan Lubricator Co., Detroit
Peiler & McKenzie, Montreal, Que.
Wm. B. Pierce Co., Buffalo
Power Economy Co., Montreal

Boilers.

Babcock & Wilcox, Montreal
Goldie & McCulloch Co., Galt.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jones Underfeed Stoker Co., Montreal.
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Standard Engineering Co., Toronto
Waterous Engine Works Co., Brantford.

Boilers, Horizontal Tubular.

Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough, Ont.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Boilers, Locomotive

Jno. Inglis Co., Ltd., Toronto
Goldie & McCulloch Co., Galt, Ont.

Boilers, Marine.

Babcock & Wilcox, Montreal
Goldie & McCulloch Co., Galt.
The Wm Hamilton Co., Peterborough.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Boilers, Vertical.

Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Boilers, Water Tube.

Babcock & Wilcox, Montreal
The John Inglis Co., Ltd., Toronto
Polson Iron Works, Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.

Boosters.

Geo. C. Royce, West Toronto

Brine Coolers.

Vilter Mfg. Co., Milwaukee, Wis.

Canners' Machinery.

J. C. Wilson & Co., Glenora, Ont.

Cars, Transfer.

Corbet Foundry and Machine Co., Owen Sound

Castings, Brass.

Hercules Float Works, Springfield, Mass,
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
J. C. Wilson & Co., Glenora, Ont.

Cement Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
Jno. McDougall Caledonian Iron Works, Montreal

Chain Drives.

Jones & Glassco, Montreal
John Millen & Sons, Montreal

Chemicals.

Dearborn Drug and Chemical Works Chicago
Nichols Chemical Mfg. Co., Montreal

Circuit-Breakers.

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Coal and Ash Conveyors.

Babcock & Wilcox, Montreal
Peiler & McKenzie, Montreal, Que.

Coal Handling Machinery

Standard Engineering Co., Toronto

Cold Storage Architects.

E. J. Greenstreet, Toronto

Condensers.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
J. P. Devine Co., Buffalo, N.Y.
Goldie & McCulloch Co., Galt.
Jno. Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Peiler & McKenzie, Montreal, Que.
Vilter Mfg. Co., Milwaukee, Wis.

Consulting Engineers.

Bain & Mitchell, Montreal
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de Gaspe Beaubien, Montreal.
Rowland Brittain, Vancouver, B.C.
W. S. Brooke, Toronto
Cleveland & Cameron, Vancouver, B.C.
Dutcher & Foreman, Vancouver, B.C.
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J. F. Frew, Vancouver, B.C.
Galt & Smith, Toronto.
E. J. Greenstreet, Toronto
John S. Isdale, Vancouver, B.C.
F. M. G. Johnson, Montreal
Laurie & Lamb, Montreal
Marchand & Donnelly, Ottawa, Ont.
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C. H. & P. H. Mitchell, Toronto
Moore & Scollan, Toronto
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Morris Engineering Co., Vancouver, B.C.
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J. M. Shanly, Montreal.
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Contractors, Structural Steel

Canadian Fairbanks Co., Ltd., Montreal
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Conveyor Machinery.

Canadian Fairbanks Co., Ltd., Montreal
Jno. McDougall Caledonian Iron Works, Montreal

Cork Insulation.

Canadian Fairbanks Co., Ltd., Montreal
Linde British Refrigeration Co., Montreal

Couplings.

Canadian Fairbanks Co , Ltd , Montreal
J. C. Wilson & Co., Glenora, Ont.

Cranes, Electric.

Babcock & Wilcox, Montreal
Jno. McDougall Caledonian Iron Works Montreal

Crank Pins.

Michigan Lubricator Co., Detroit
Sight Feed Oil Pump Co., Milwaukee, Wis.

Cross Head Pins.

Michigan Lubricator Co., Detroit
Sight Feed Oil Pump Co., Milwaukee, Wis

Crushing Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd,, Montreal

Damper Regulators.

Darling Bros., Montreal
Julian d'Este Co., Boston, Mass.
Peiler & MacKenzie, Montreal
Standard Engineering Co., Toronto

Dredges.

Allis-Chalmers-Bullock, Ltd., Montreal

Drills, Rock.

Allis-Chalmers-Bullock, Ltd., Montreal

Drying Machinery.

Canadian Fairbanks Co., Ltd., Montreal
J. P. Devine Co., Buffalo N.Y.
Jno. Inglis Co., Ltd., Toronto

Dynamos.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co , Ltd , Montreal
Canadian Westinghouse Co., Hamilton
Mechanical & Elec. Lab., Buffalo
Electrical Maintenance & Repair Co., Toronto.

Economizers.

Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal

Electric Power Instalations.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton

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Matthews & Yates, Manchester

Electrical Accessories.

Canadian Fairbanks Co , Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Toronto

Electrical Machinery.

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Canadian Westinghouse Co., Hamilton
Chapman & Walker, Toronto

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Electrical Maintenance & Repair Co., Toronto.
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Engines, Automatic.

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Robb Engineering Co., Amherst, N.S.

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Jno. Inglis Co., Ltd., Toronto
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Jno. McDougall Caledonian Iron Works, Montreal

Engines, High Speed, Steam.

Goldie & McCulloch Co., Galt.
The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

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Jno. Inglis Co., Ltd., Toronto

Engines, Medium and Low Speed.

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The Wm. Hamilton Co., Peterborough.
The John Inglis Co., Ltd., Toronto
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Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Rocking Valve.

The John Inglis Co., Ltd., Toronto

Engines, Saw Mill.

Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough.
The John Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Bran ford

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Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal
Jno. McDougall Caledonian Iron Works, Montreal
Kerr Engine Co., Walkerville
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Engines, Slide Valve

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Engines, Vertical.

The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.

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Matthews & Yates, Manchester

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Darling Bros., Montreal
Standard Engineering Co., Toronto.
Watson & McDaniel Co., Philadelphia

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Reliance Gauge Column Co., Cleveland, Ohio

Feed Water Analyser.

Dearborn Drug and Chemical Works, Chicago

Feed Water Heaters

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Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
Goulds Pump Co., Montreal.
The Wm. Hamilton Co., Peterborough.
The John Inglis Co., Ltd., Toronto
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National Pipe Bending Co., New Haven, Conn.
Peiler & MacKenzie, Montreal
Robb Engineering Co., Amherst, N.S.
Standard Engineering Co., Toronto
The Stewart Heater Co., Buffalo, N.Y.

Feed Water Regulators

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Harbison-Walker Refractories Co., Pittsburg, Pa.

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Harbison Walker Refractories Co., Pittsburg, Pa.

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Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Drummond, McCall & Co., Montreal
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Peiler & McKenzie, Montreal, Que.
Reliance Gauge Column Co., Cleveland, Ohio

Gauges, Pressure, Vacuum and Recording.

Babcock & Wilcox, Montreal
Lunkenheimer Co., Cincinnati, Ohio
Peiler & MacKenzie, Montreal

Gears, Angle.

The Wm. Hamilton Co , Peterborough
Jno. McDougall Caledonian Iron Works, Montreal
J. C. Wilson & Co., Glenora, Ont.

Gears, Cut.

J. C. Wilson & Co., Glenora, Ont.

Gears, Mortise.

J. C. Wilson & Co., Glenora, Ont.

Gears, Reducing

Jno. McDougall Caledonian Iron Works, Montreal

Gears, Worm.

J. C. Wilson & Co., Glenora, Ont.

Generators.

Allis-Chalmers-Bullock, Montreal
Canadian Electrical & Motor Co., Toronto
Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto

Governors.

Allis-Chalmers-Bullock, Ltd., Montreal

Governors, Water Wheel.

J. C. Wilson & Co., Glenora, Ont.

Graphite.

Jos. Dixon Crucible Co., Jersey City

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Diamond Grate Bar Co., Berlin, Ont.
The John Inglis Co., Ltd., Toronto
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Gravity Closing Ventilators.

Standard Engineering Co., Toronto.

Grease Cups.

Detroit Lubricator Co., Detroit.
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
Power Economy Co., Montreal

Grease and Oil Extractors.

C. Jacobs & Co., Boston, Mass.

Greases

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Canadian Oil Companies, Toronto
Jos. Dixon Crucible Co., Jersey City
Electric Boiler Compound Co., Guelph.

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Goldie & McCulloch Co., Galt.
Jno. McDougall Caledonian Iron Works, Montreal
Waterous Engine Works Co., Brantford
J. C. Wilson & Co., Glenora, Ont.

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Matthews & Yates, Manchester

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Peiler & McKenzie, Montreal, Que.
The Stewart Heater Co., Buffalo, N.Y.

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Escher, Wyss & Co., London, Eng.
Linde British Refrigeration Co., Montreal
Vilter Mfg. Co., Milwaukee, Wis.

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Canadian Westinghouse Co., Hamilton
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Indicators, Steam Engine.

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Peiler & MacKenzie, Montreal

Indicators, Water.

Detroit Lubricator Co., Detroit

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Penberthy Injector Co., Windsor.

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Lamps, Incandescent

Canadian Westinghouse Co., Hamilton
Chapman & Walker, Toronto

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Standard Engineering Co., Toronto

Meters, Electric

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Geo. C. Royce, West Toronto.

Meters, Water

Drummond, McCall & Co., Montreal
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Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
Madison Williams Mfg. Co., Lindsay, Ont
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford
J. C. Wilson & Co., Glenora, Ont.

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Geo. C. Royce, West Toronto

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Detroit Lubricator Co., Detroit

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Power Economy Co., Montreal

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Canadian Oil and Waste Saving Machin Co., Brockville, Ont.

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C. Jacobs & Co., Boston, Mass.
Liberty Mfg. Co., Pittsburg
Peiler & MacKenzie, Montreal
Power Economy Co., Montreal
Standard Engineering Co., Toronto

Oils, Lubricating.

Canadian Oil Companies, Toronto
Dearborn Drug and Chemical Works, Chicago
Electric Boiler Compound Co., Guelph Ont.

Packing, Leather.

Electric Boiler Compound Co., Guelph Ont.
Garlock Packing Co., Hamilton

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Peiler & McKenzie, Montreal, Que.
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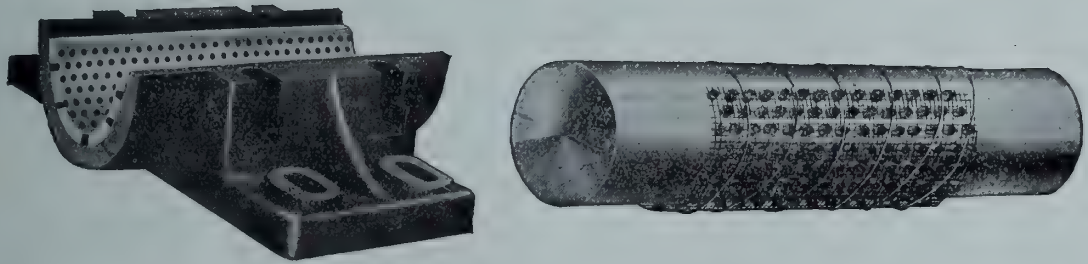

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The John Inglis Co., Ltd., Toronto
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Corbet Foundry and Machine Co., Owen Sound
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Peiler & McKenzie, Montreal

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J. P. Devine Co., Buffalo, N.Y.
The John Inglis Co., Ltd., Toronto

Vacuum Pumps.

Canadian Steam Boiler Equipment Co. Toronto
J. P. Devine Co., Buffalo, N.Y.
The John Inglis Co., Ltd., Toronto

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Canadian Steam Boiler Equipment Co. Toronto
Darling Bros., Montreal
Peiler & MacKenzie, Montreal
Standard Engineering Co., Toronto

Vacuum Traps.

Peiler & McKenzie, Montreal, Que.
Morehead Mfg. Co., Detroit, Mich.

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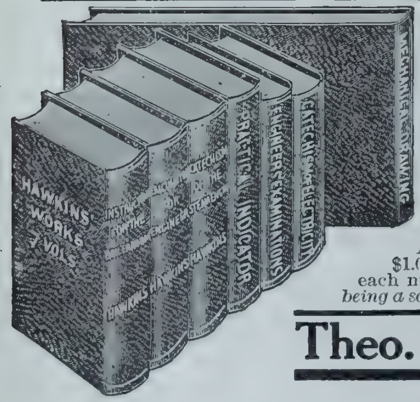

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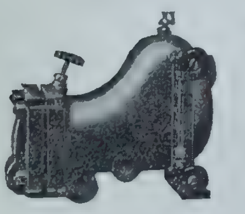

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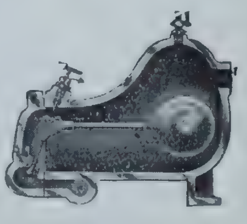

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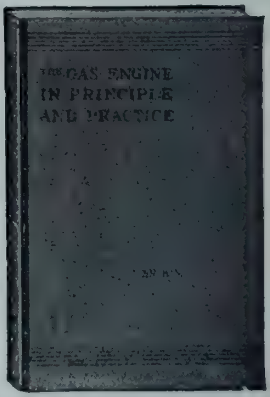

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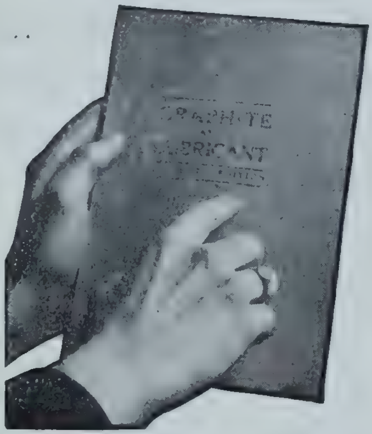

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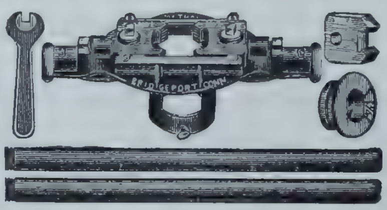
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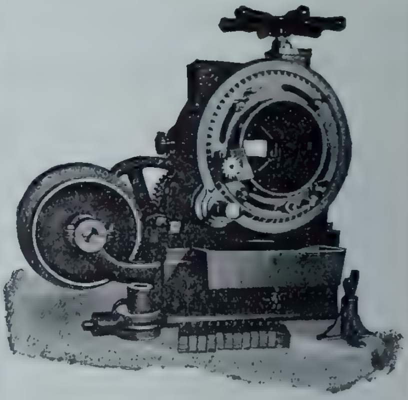

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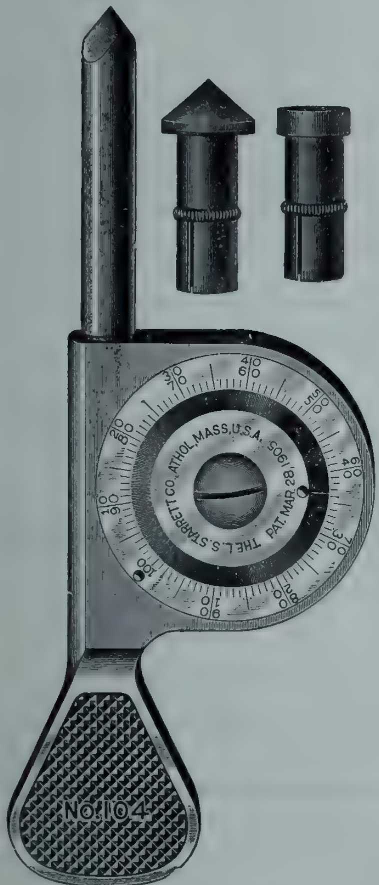
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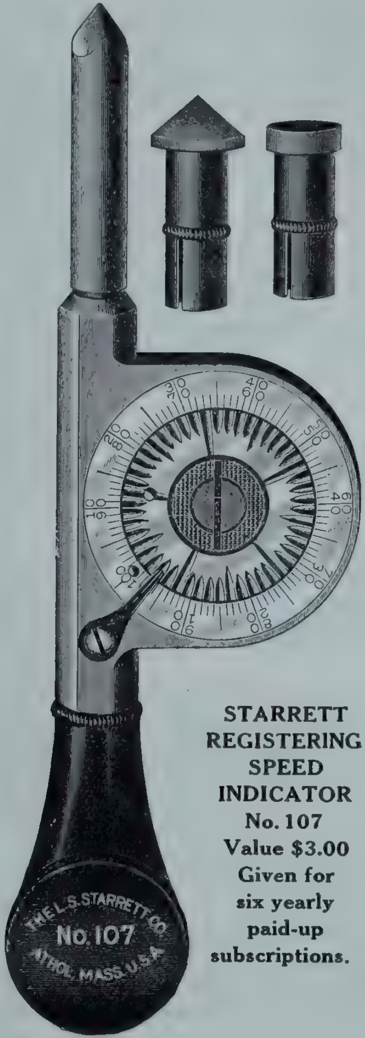

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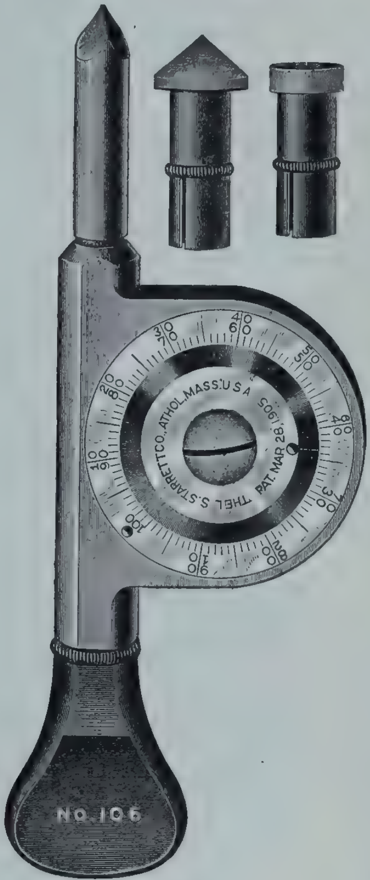
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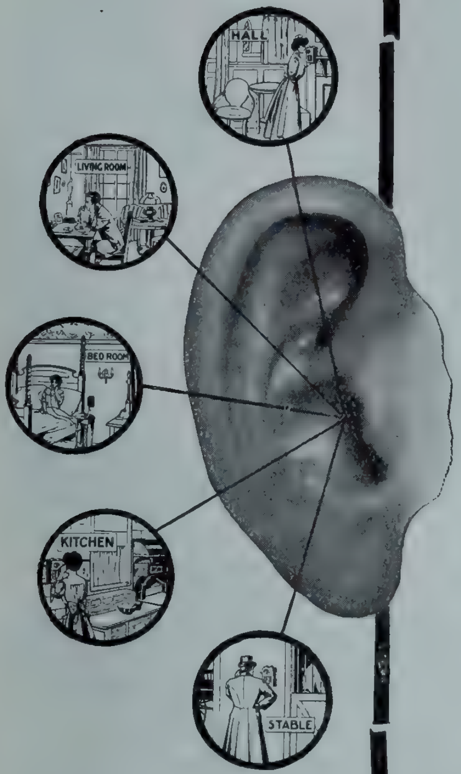

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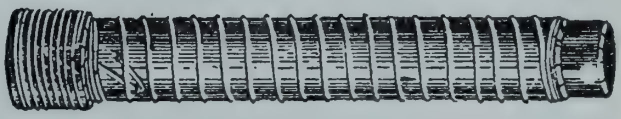

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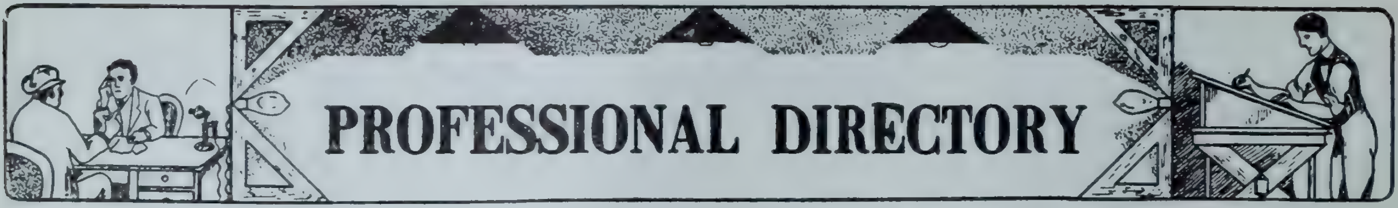

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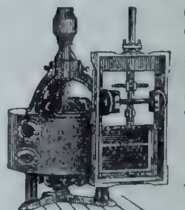

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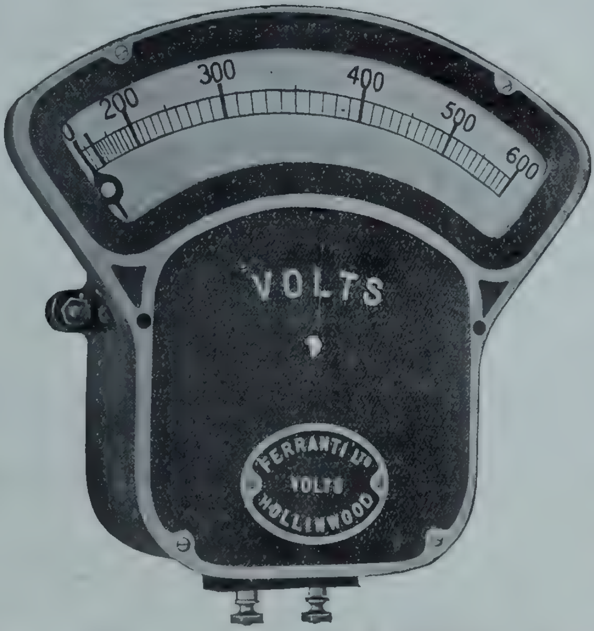

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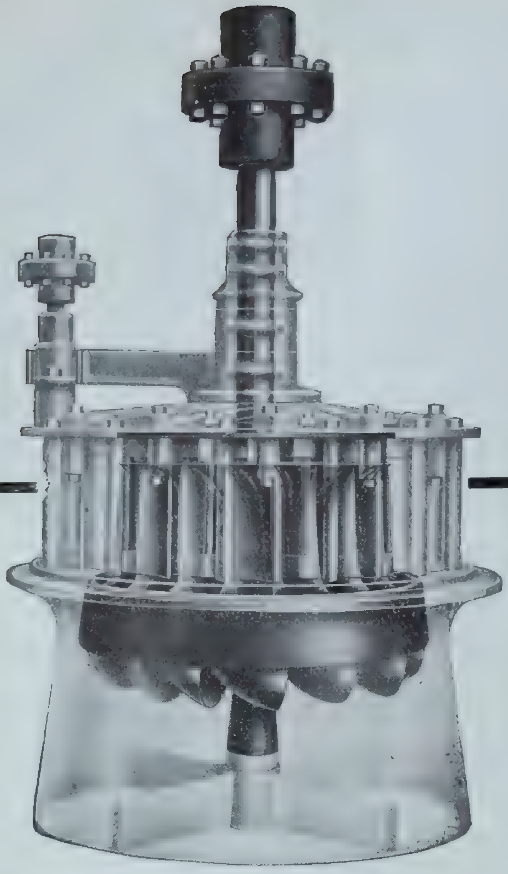

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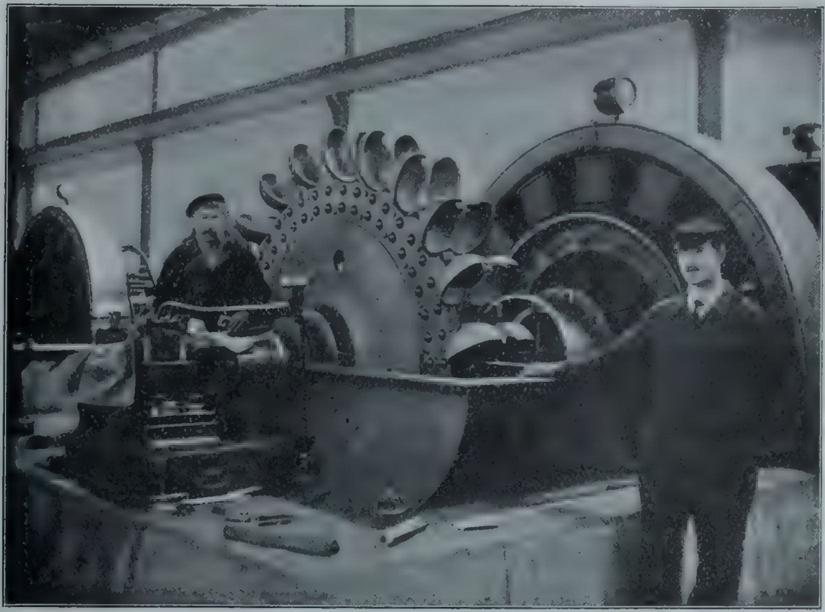

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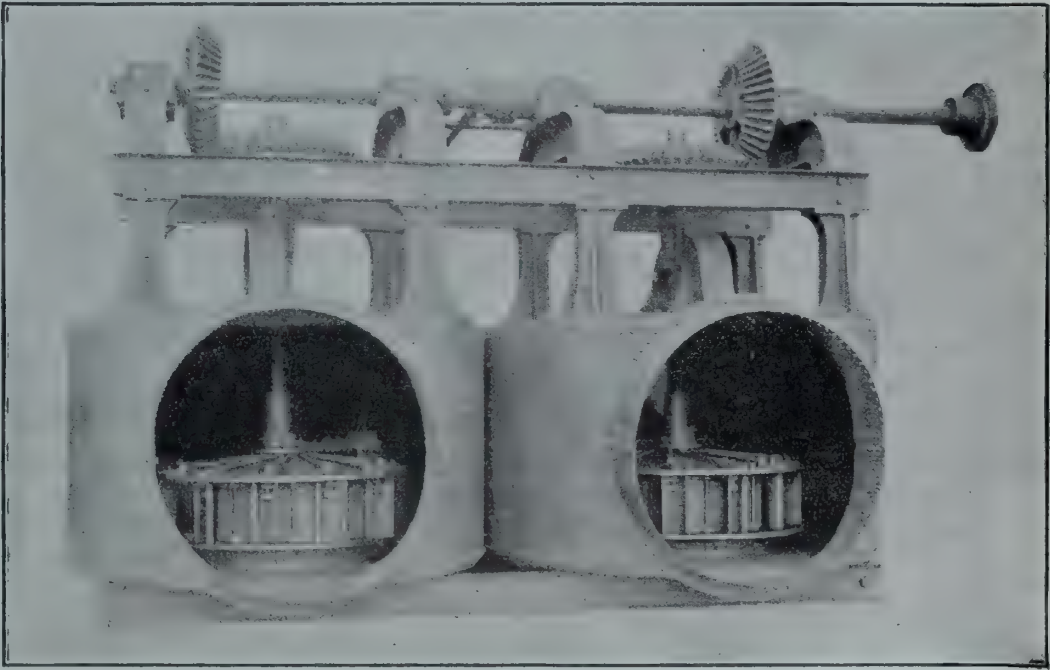

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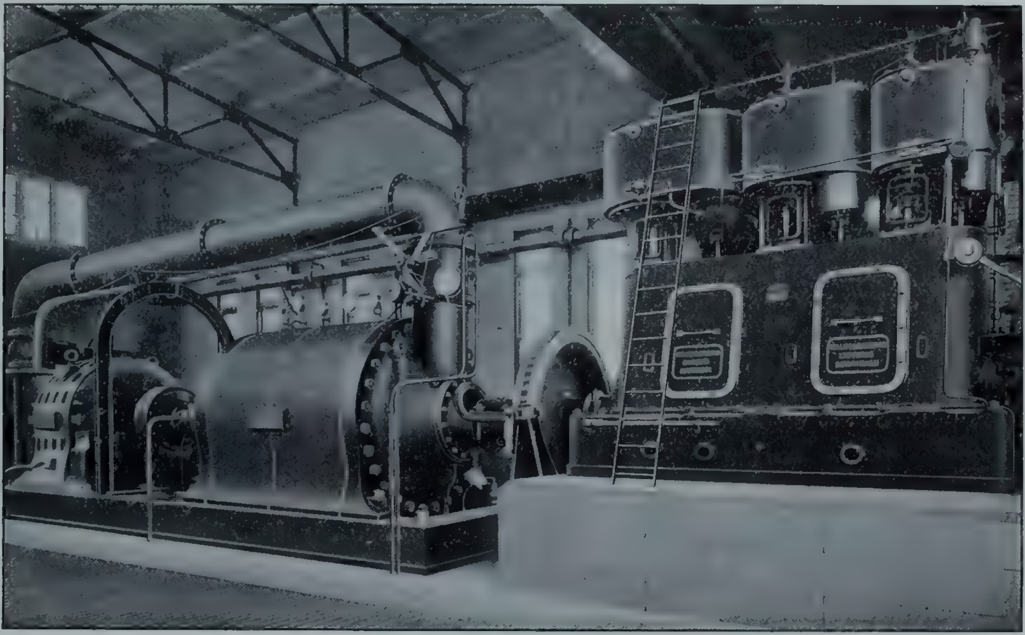

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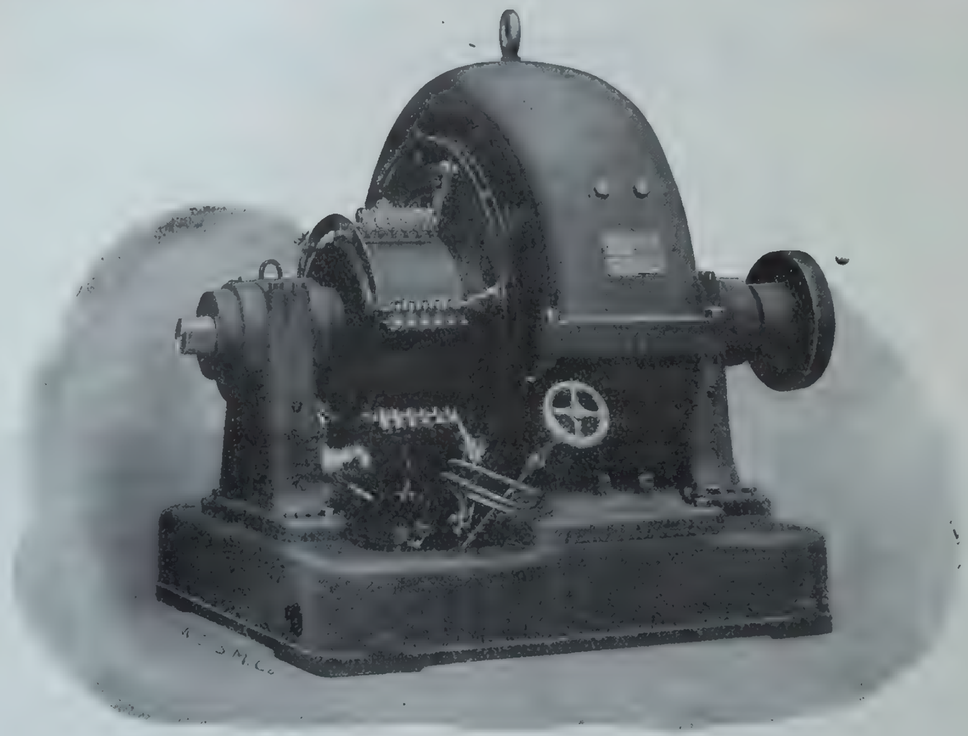

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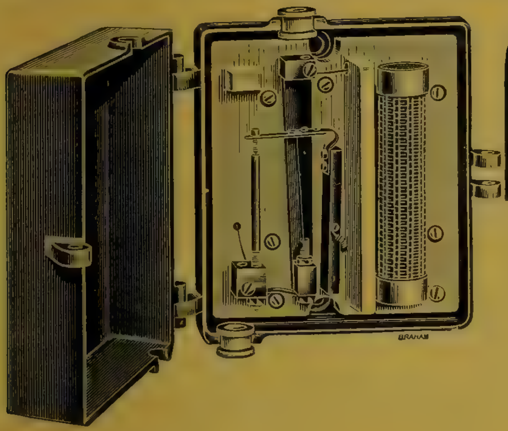

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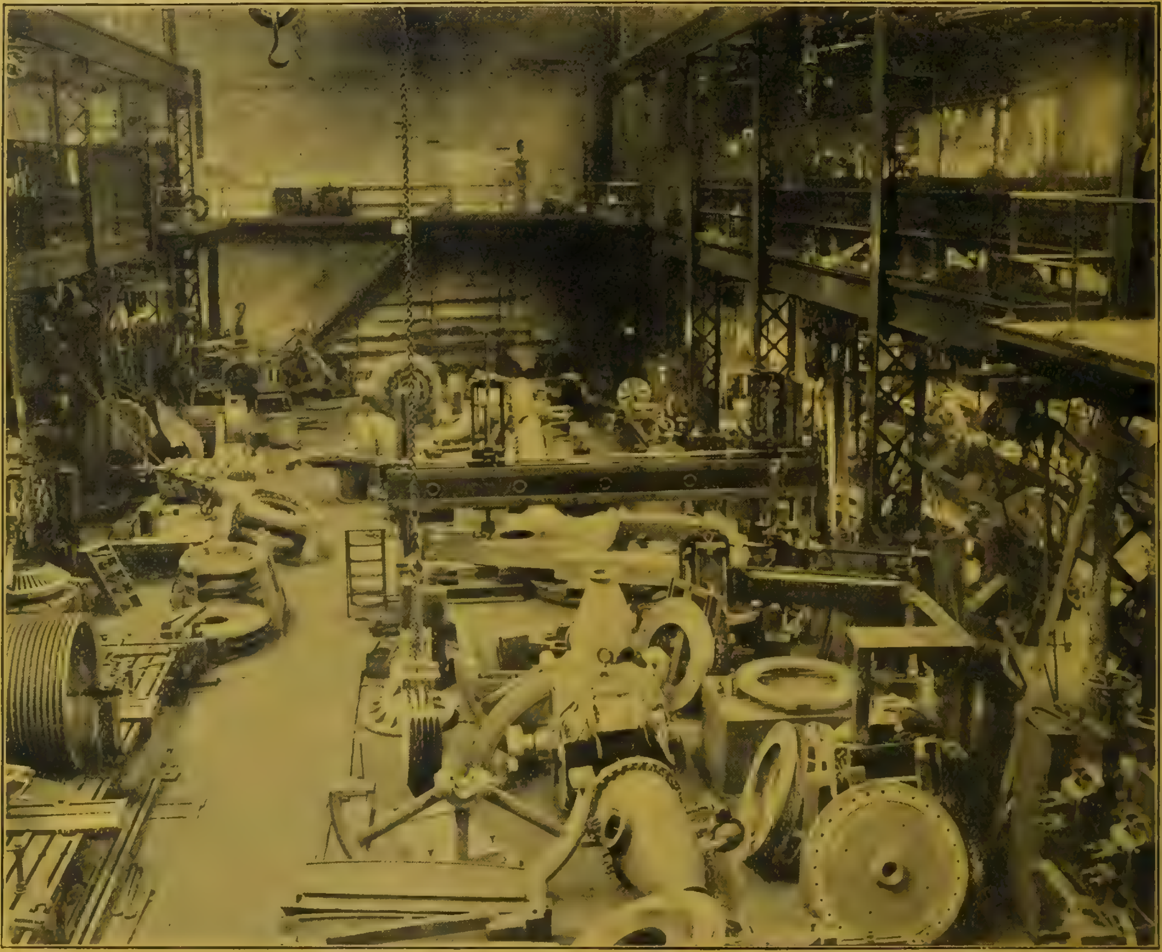

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They are built right.
We have a modern shop with up-to-date equipment.
Our men are experienced.
We use only the best material.
Each boiler is rigidly inspected before shipping.
We can promise on-time delivery.

Let Us Quote on Your Specifications

The
Waterous Engine Works Co., Ltd.
Brantford, :: Canada

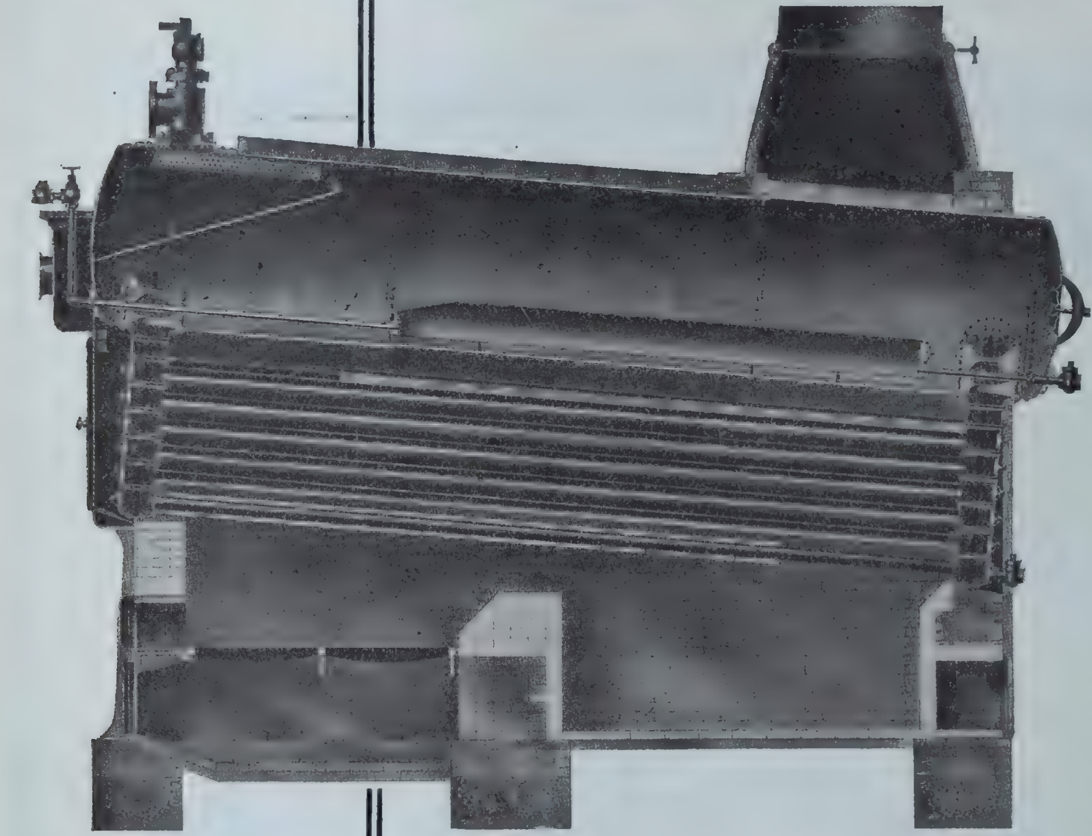
Over 125,000,000 H.P. of Heine Boilers in use in the United States.

Here's a strong statement!

But one to the truth of which thousands of Power Plant Owners can testify!

In point of ECONOMY, EFFICIENCY, SAFETY and DURABILITY the best on the market for every size plant is the

HEINE SAFETY BOILER



¶ Its economy and capacity are determined by the fact that it is the best boiler for rapidly absorbing and transmitting heat; moreover, it separates the water from the steam, thus ensuring dry steam at the piston.

¶ Another feature is the HEINE DRUM, which effectively precipitates and discharges all scale and mud from the boiler.

¶ The HEINE BOILER will hold high pressures with safety because of the careful selection of raw materials, the skill employed in every detail of its manufacture, and the numerous severe tests to which it is subjected, both during the making and after it has been put together as a completed boiler.

As an actual or prospective buyer you are invited to make the fullest enquiries.

Our Literature will interest every user of Steam.

Send for it to-day.

Polson Iron Works, Ltd.

Toronto, Ont.

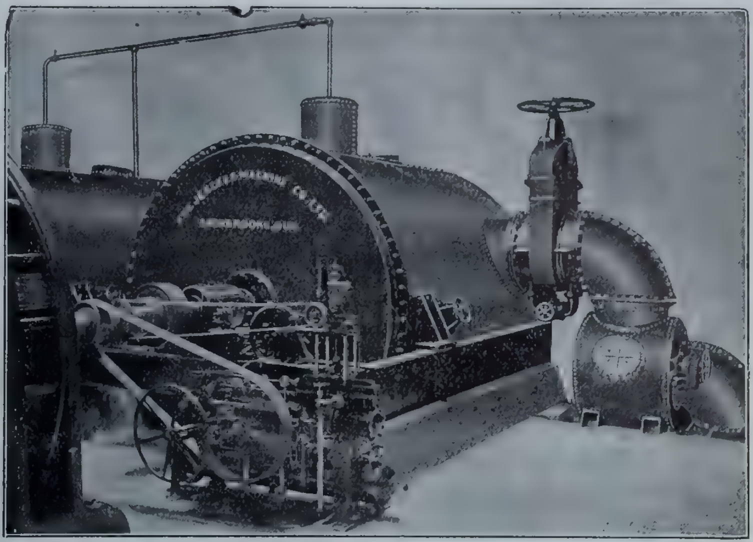
Agents for Quebec—Watson Jack & Co., 79 Power Bldg., Montreal.

Our Improved
TURBINE

is perfectly adapted for Hydro-Electric Installation.

We build it in all sizes and arranged for any setting.

We invite inquiries and will send our catalogue on request.



The Jenckes Machine Co., Limited

WORKS:
Sherbrooke, Que. St. Catharines, Ont.

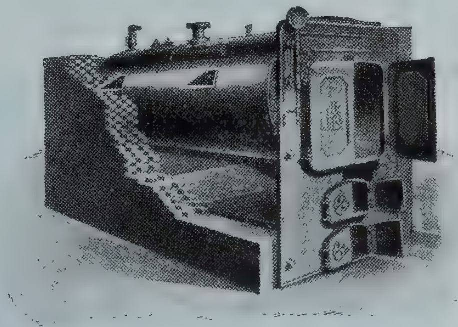
SALES OFFICES:
Sherbrooke Montreal St. Catharines Cobalt Vancouver
Kindly address nearest Sales Office.

Agents for
National Gas Engine Co.
Browett, Lindley & Co. Limited

ENGINES

CORLISS—Girder or Heavy Duty Frame, Medium or Slow Speed, Simple, Tandem or Cross Compound
HIGH SPEED AUTOMATIC—Simple, Tandem, or Cross Compound
TANGYE—Medium Speed, Side Crank, Simple or Twin, Heavy Frame
CLIPPER and LEONARD—High Speed, Throttling Governor
BROWETT, LINDLEY—Vertical, Quick Revolution, Forced Lubrication
NATIONAL GAS ENGINES AND SUCTION GAS PRODUCERS

BOILERS
ALL TYPES AND SIZES
Stationary, Return Tubular, Upright Locomotive—on wheels or skids
Eclipse Semi-Portable, Internal Furnace, Water Tube
HEATERS, TANKS, DIGESTERS, RETORTS, SMOKE STACKS,
PUMPS, CONDENSERS
Write for Information and Prices



E. LEONARD & SONS
London - Canada
Agencies at Montreal - St. John, N.B. - Vancouver - Calgary - Toronto - Winnipeg

"THE Cyclone"

Shaking and Dumping Grate Bar

This is the Grate Bar that will generate more steam from the amount of fuel consumed than any other grate in the world. It is the one grate from which you can get the maximum results from such cheap fuel as Soft and Hard Coal Screenings, Hard or Run-of-mine Coal, etc.

The reason is very simple. The construction of the "CYCLONE" Bar allows 68 per cent. of air space and 90 per cent. underdraught. It has greatly improved shaking mechanism that keeps it absolutely free from clinkers and prevents any waste of fuel.

The "Cyclone" locks level; cannot get out of adjustment; will never warp.

We can show you scores of highly appreciative letters from well-known business houses of which the one printed here is typical. *Read it :*

Why continue using an inferior and less economical grate when the

"*Cyclone*"

is at your service? Write us to-day for our illustrated circular.

Canadian Steam Boiler Equipment Co.
Toronto.

GENTLEMEN :

We are sending you to-night, through our Head Office in Montreal, an order for another set of Cyclone shaking and Dumping Grate Bars for one of our boilers. We are glad to say that we have no reason whatever to regret the installation of the first set of these bars. We have now had them in operation several months, and we find that we get more perfect combustion and much better fires and greater economy in our use of coal with these bars than we have had from any system of firing that we have tried at this Mill. It is our intention, during the coming summer months, to complete the installation of these grate bars under our other four boilers.

Yours truly,
The Canadian Colored Cotton Mills Co.
Ltd., St. Croix Mill.
J. W. GRAHAM, Manager.

Canadian Steam Boiler Equipment Co., Limited

(Sole Manufacturers for Canada)

186 Queen Street East, - TORONTO

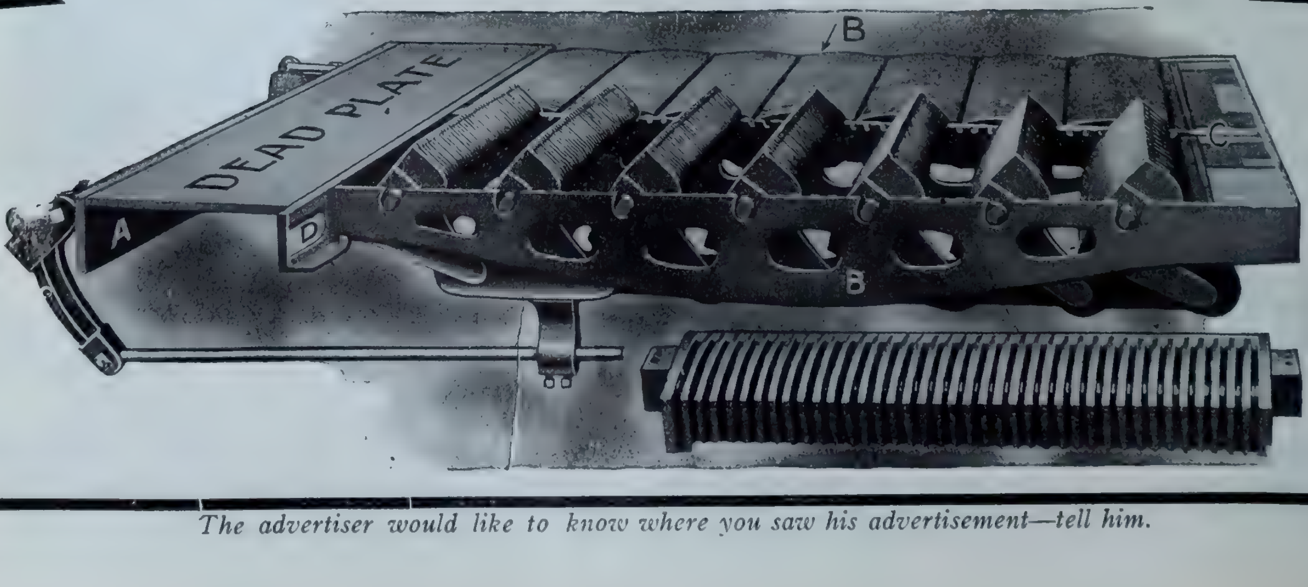
AGENTS :

ST. JOHN, N.B.—F. W. BLIZZARD, Canada Permanent Chambers.

MONTREAL—LOWDEN & MEAD, 18 Bleury Street

HAMILTON—ROBT. FITZSIMMONS, 8 Grove Street

WINNIPEG—GREEN & LISTER, Heating Engineers.



ENGINES AND BOILERS

Single, Compound and Triple

Corliss Engines
for light and heavy duty.

Power Engines
Slide Valve, Rocking Valve

Marine Engines
Triple Expansion, Single Compound, Steeple Compound, Quadruple, Incline, and Tug Engines.

Pumping Engines
and Pumping Machinery.

Scotch Marine Boiler, 14 ft. in diameter, built for the Richelieu and Ontario Co's. Steamer "Rapids Prince."

Return Tubular
Fitzgibbon
Locomotive
Scotch Dryback
Scotch Marine
Vertical
Submerged Tube
WATER-TUBE
Vertical and Horizontal

Photos, Specifications and Prices Upon Request.

THE JOHN INGLIS COMPANY, LIMITED

ENGINEERS AND BOILERMAKERS

14 STRACHAN AVENUE - - - - TORONTO, CANADA

If You Desire to Save Troubles in Your Boiler Room—Use

The "P.B.H." QUICK CLOSING WATER GAUGE is an accident insurance against scalds and burns. If the glass breaks, a pull of the chain shuts off both the steam and water. Its structure is perfect; extra heavy body, best steam metal with extra large nuts for extra heavy washers. Less than a quarter turn of stem fully closes or opens valves. **Sent on Trial.**

The "**TORNADO**" STEAM BOILER TUBE CLEANER not only does the work better than any other cleaner but does it in shorter time and more economically. Because the air injected by a small volume of steam carries no moisture to wet the soot but blows it out through the longest tubes. **Sent on Trial.**

The "P.B-H." QUICK OPENING, SELF-CLOSING GAUGE COCK; it is simple, efficient, economical and quickly repaired. It combines all the mechanical perfections which make it a GAUGE COCK. GUARANTEED LEAKLESS for years. **Sent on Trial.**

We also make the Mather Blow-off Pipe Protector. Have you seen it? Do you know what it is?

WRITE FOR CATALOGUE

The PAUL B. HUYETTE CO., Inc.

1414 Betz Building - Philadelphia, Pa.

Selling Agents for Western Ontario and North-West: **Canadian Steam Boiler Equipment Co., 186 Queen Street East, Toronto**
Selling Agents for Province of Quebec and Eastern Ontario: **Peiler & MacKenzie, 52 St. James St., Montreal, Canada**
Selling Agents for Maritime Provinces and Newfoundland: **Peiler, MacKenzie & Lodge, Moncton, N.B.**

The advertiser would like to know where you saw his advertisement—tell him.

THE COST OF SMOKE

¶ What proportion of the coal fed to the locomotive is actually used in power?

¶ About 6 per cent.; the rest is wasted.

¶ What part of the fuel value of their coal do the furnaces of the great manufacturing plants actually apply to driving the machiner?

¶ Not over 10 per cent.; often less.

¶ The rain of cinders from the locomotive, the pillar of black smoke from the factory chimney, account conspicuously for the waste. The great loss, however, is in the form of unconsumed gases which escape into the air without having been of any steam-producing value.

¶ These gases escape because, as is well known, perfect combustion has never been discovered as yet. The gases escape from the coal so rapidly that, before they are mixed with the necessary air (providing oxygen) they have passed away from the point of combustion—which is at the surface of the burning coal.

¶ The rescue of a small proportion of the 90 per cent. of fuel value thus wasted would mean a large proportion of the 10 per cent. now ordinarily used.

¶ This should be easily done.

¶ It has been done, and is being done. It can be done in every plant—in yours with the rest. Chemistry has produced in the *FISHER FUEL ECONOMIZER* a substance which when applied to the coal forms an exceedingly thin film over it and causes the valuable heat-producing gases to be held in the coal itself, and the coal and the gases are consumed together, thus preventing the waste of valuable gases which take place when the coal is consumed without the treatment.

¶ Indisputable evidence is available that by the use of

FISHER FUEL ECONOMIZER

Black smoke and flying cinders are eliminated, which has been proved on locomotives pulling the fastest passenger as well as the heaviest freight trains. Many evaporation tests in the power plants of the largest corporations in Canada show increase of efficiency ranging from 10 to 25 per cent.

¶ We save money for the factory owner and railway.

¶ We save the fireman much hard and dirty work.

¶ We save the black smoke which pollutes the air.

¶ We reduce your ashes and clinkers half.

¶ We increase and maintain steam to a degree which is impossible without the economizer.

¶ We eep your boiler tubes and grate bars clean, reducing expense of upkeep.

Let Us Prove It to You. Write To-day for Information

Phone Main 2390

Fisher Fuel Economizer Limited

Head Office, 74 Bay St., Toronto, Ont.

MONTREAL
212 St. James Street
Phone Main 3497

OTTAWA
35 Mackay Street
Phone 1879

WINNIPEG
310 McGreevy Block
Phone Main 2750

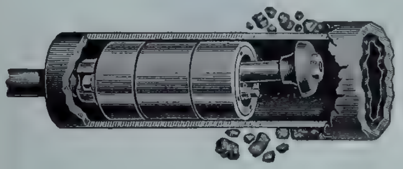
Saved $2 a Week on One Boiler

Doesn't seem much but multiply it by 52 and it's quite a bit. That's what one concern made by using

The Dean Boiler Tube Cleaner

Where there are several boilers and the scale heavy the Dean has saved $150.00 to $1200.00 a year. That's why we can afford to guarantee to every purchaser that the Dean will pay for itself in six months' use. Why not try a Dean in one of your boilers and see how much you can save.

Write for booklet No. 130 and our free trial offer

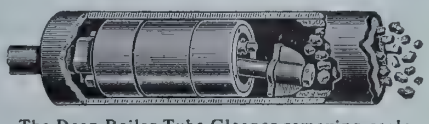


The Dean Boiler Tube Cleaner removing scale from the tube of a return tubular boiler.

THE WM. B. PIERCE CO.

330 Washington Street, Buffalo, N.Y.

Montreal Office : 230 Coristine Bldg., Montreal.



The Dean Boiler Tube Cleaner removing scale from the tube of a water tube boiler.

The Nichols Chemical Company, Limited

HEAD OFFICE: 222 ST. JAMES ST., MONTREAL

ACIDS AND CHEMICALS

WORKS:
Capelton, Que.
Sulphide, Ont.
Barnet, B.C.

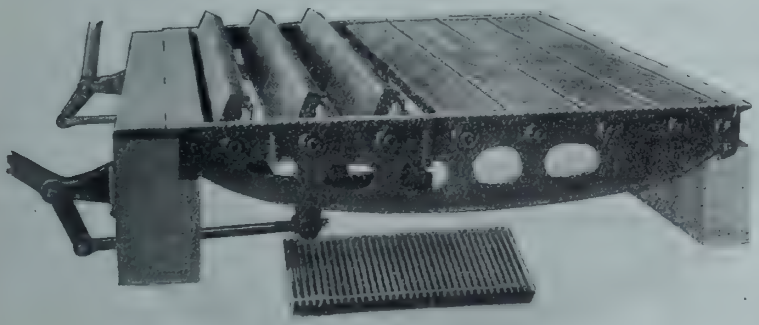
TRI-SODIUM PHOSPHATE

Purest Commercial, 100%, for prevention of scale in boilers.

WAREHOUSES:
Toronto, Ont.
Montreal, Que.

"CAPITAL" SHAKING AND DUMPING GRATE

PATENTED 1910



A comparison of this grate with other shaking grates will show many advantages; the bearings are 3½ inches below the fire, thus ensuring against their burning out rapidly, the sections are easily removed and replaced at low cost, easily operated, greater air space. Send for particulars to

Butterworth Foundry, Limited

OTTAWA

There is no Cure-all for Boiler Scale — Every case must be treated the Dearborn way- individually.

There's just this one logical way to prevent boiler scale:

Get a skillful chemist to analyze your feed-water and determine just what scale-forming elements it contains. Then have him make up some compound to fit your particular case.

In a nutshell, that is the Dearborn Treatment.

Every year we analyze about 8,000 samples of feed-water—we maintain a modern laboratory and a staff of expert chemists for the purpose.

Every year more and more boiler owners and engineers are adopting the Dearborn Treatment, simply because REASON tells them and RESULTS prove that it is the ONE treatment that is absolutely sure and safe.

Better get in line with the other progressives and express us a gallon sample of your feed-water for free analysis.

In any case write us at once for
the handsome and instructive
Dearborn Catalogue — Free.

Dearborn Drug & Chemical Works

Robert F. Carr, President

General Offices, Laboratory and Works, Chicago
General Eastern Offices, 299 Broadway, New York

Branch Offices in Principal Cities

Don't Waste Time

or expense cleaning scaly tubes! any money spent in preventing scale is a far more profitable outlay than what it costs to remove the scale after it has formed. Prevent scale by using

INTERNATIONAL
BOILER COMPOUND

But we can't work in the dark; we must find out what your feed water contains before we can mix the compound that will eliminate the scale-forming salts. Express us one gallon of your feed water; we will analyse it *free of charge,* and will forward a TRIAL SAMPLE of our compound guaranteed to banish all your Scale Troubles.

You can make money acting as our agent. Write for details of our offer.

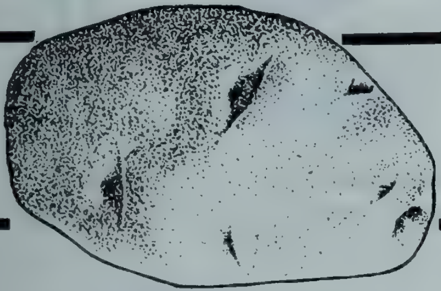
Get in touch with us to-day.

International Boiler Compound Company

144-146 West Michigan St., Chicago, Ill., U.S.A.

"Prevention is Better than Cure"

An old proverb which was never so true as when applied to the *Scale Problem!*



Prevent **the formation of Boiler Scale by treating your Feed Water with**

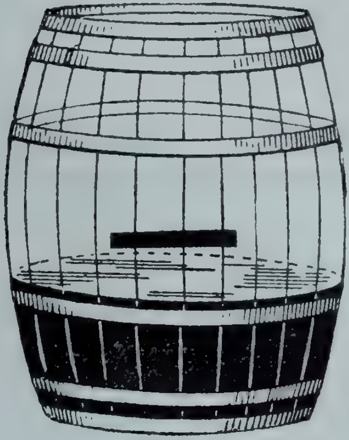
POTATO SCALE BOILER CLEANSER

It will save fuel, keep your Boiler from foaming and is guaranteed not to injure tubes, shell or connections. Send me one gallon of your *Feed Water* and I will forward a compound which I will guarantee to free your Boiler from scale and to keep it free.

Sole Agent in America **C. C. SNOWDEN**

All letters to Calgary **Calgary, Alberta**

Price Value



If a barrel containing 500 lbs. of liquid boiler compound is sold to you for 7c a pound, you can figure that about 125 lbs. of the contents of the barrel are chemicals and 375 lbs. are water. Your figures will show that you really pay $35 for 125 lbs. of chemicals or, in other words, the chemicals have cost you 28c a pound. If you want to look at it in another way you can say that you have purchased 375 lbs. of water at 7c a pound. You may not wish to admit that you have paid 7c a lb. for water, then it will be necessary for you to acknowledge that you have paid 28c a pound for chemicals.

Some of these liquid preparations are sold for as low as 3 to 4c a lb. On the same basis as the above the actual chemicals themselves cost from 12 to 16c per lb. Besides that, you have to pay the freight on three pounds of water for each pound of chemicals received.

Lord's Chemicals are 100% Pure.

Lord's pure, dry chemicals, prescribed especially for your case, contain no water or other adulterations. When you pay for Lord's you pay for chemicals only. You buy Lord's chemicals for use in your boilers at about the face price of liquid or paste compounds and on the same basis that you buy other supplies used at your plant.

Pure goods cost no more than the adulterated article, and the results are so much more satisfactory that there is practically no comparison between the two.

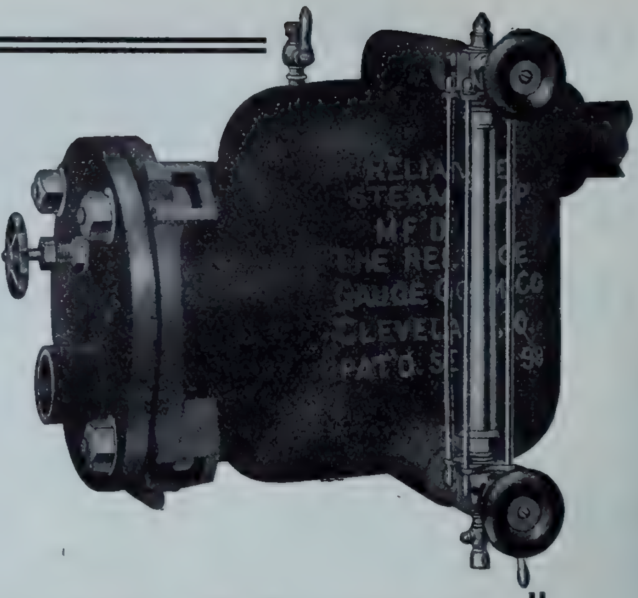
Use Lord's Chemicals and do your own watering.

George W. Lord Company
PHILADELPHIA, Pa.

The Trap that never fails!

Every progressive engineer should investigate the merits of the

Reliance Steam Trap



which is guaranteed to give longer and better service than any trap on the market. It is unlimited in capacity, and simple and practical in design, and will handle every drop of condensation, whether it comes in floods or driblets.

The "Reliance" Trap will work equally well on high or low pressure systems, and its valve is controlled entirely by the inflow of the water with an action that is positive and never failing.

Every "Reliance" Trap is fully guaranteed—including the float.

Write to-day for illustrated Catalog—Free.

The Reliance Gauge Column Co.

902 Carnegie Avenue - - - Cleveland, Ohio

THE GARLOCK PACKING CO. GARLOCK TRADE MARK HAMILTON CANADA.

GARLOCK

RING AND SPIRAL PACKING

Are You Sure you are using Genuine Garlock Packing, the kind that for years has withstood the trials of the stuffing box?

Do not accept imitations.

All genuine Garlock Packings are protected by the Garlock trademark.

Make sure you have the real thing.

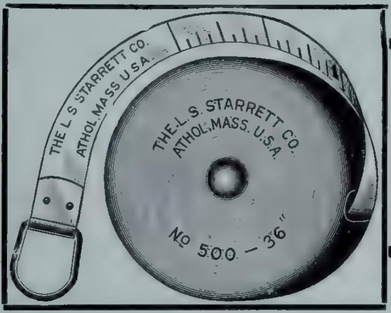
The Garlock Packing Company

Hamilton, Ontario

Would you like one of these Pocket Steel Tapes

? ? ? ? ? ? ? ? ?

You can easily earn one
without spending a cent!


THE L S STARRETT CO. ATHOL MASS U.S.A.
THE L. S. STARRETT CO. ATHOL. MASS. U.S.A.
No 500 — 36"

If you are a subscriber to *"The Power House,"* send us along two new subscribers at one dollar each, and the Tape is yours.

If not, send along your own subscription and two others.

"Simple and easy," you'll say! In fact, a recommendation of the value of *"The Power House"* to every Canadian engineer, superintendent and power user is generally sufficient for him to part with his dollar.

"The Power House" is a necessity to every wideawake engineer, because it contains all the latest and best information in the engineering field.

This handy Tape is of first-class workmanship, 1¼ inches wide, with rounded corners. The Tape itself is ¼-inch wide, accurately marked in inches and sixteenths, and is 60 inches long. Value 75c each.

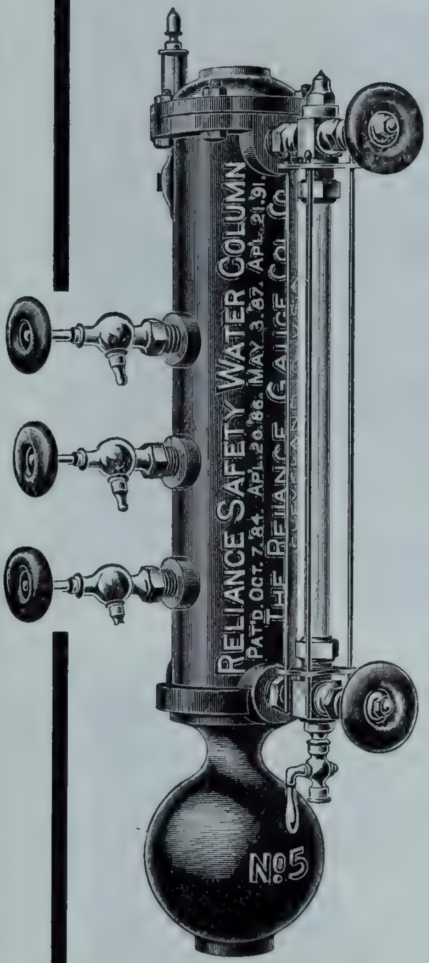
Get Busy To-day
Published Monthly at $1.00 a year

The Power House
143-149 University Ave. - - Toronto

YOU MAY BE GETTING ALONG

somehow without a

RELIANCE


RELIANCE SAFETY WATER COLUMN
PAT'D OCT. 7.84. APL. 20.86. MAY 3.87. APL. 21.91.
THE RELIANCE GAUGE COL. CO.
No 5

Safety Water Column

but you cannot help getting along better ***with it.***

It enforces the keeping of the water in the boiler at exactly the right level for absolute safety and economical fuel consumption.

Whenever the water in the boiler falls below or rises above the right level, the "Reliance" sounds an alarm whistle, thus giving warning of imminent danger to engine from too much water, and of explosion from too little water. The valves are placed well above the high-water level, and positively cannot clog.

We also make a "Reliance" Column for Low Water Alarm *only.*

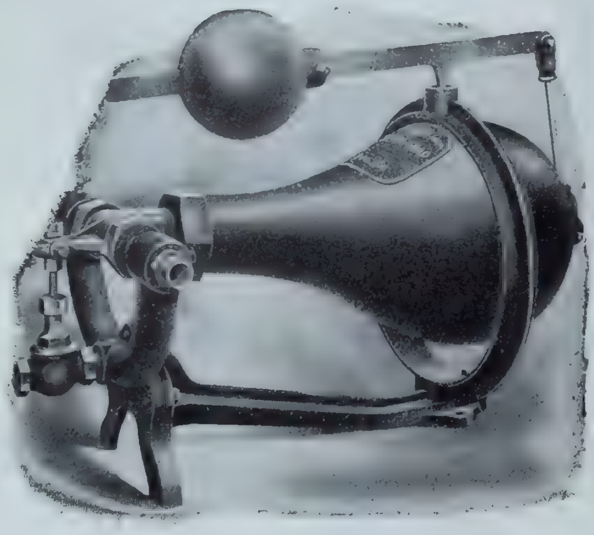
Our Illustrated Catalogue is free; send for a copy to-day.

The Reliance Gauge Column Company

5902 Carnegie Ave., Cleveland, Ohio

The Reason Why

THE "BUNDY" STEAM TRAP



occupies its present unique position in the mechanical world is

Because The Results

achieved by its use, both in increased efficiency and decreased fuel bills,

Have not been attained through any other similar appliance

Every owner, superintendent and engineer in whose plant steam is used for heating, boiling or drying, is interested in learning what we can do to decrease operating cost and to increase output.

We are effecting direct fuel economies of from 15% to 50% in some of the largest industrial establishments in Canada. No plant is too large and none too small to have the full benefit of our experience.

We are Specialists in condensation and we show results.

Catalogues and detailed information are available on request

PEILER & MACKENZIE, - 52 St. James Street
MONTREAL

PEILER, MACKENZIE & LODGE - Moncton, N.B.

Sales Agents for

"BUNDY" Steam Traps and Separators

CANADIAN ASSOCIATION of STATIONARY ENGINEERS

To the Stationary Engineer who is not a member of the C.A.S.E. :

Can a true, progressive engineer afford to be outside of our organization ?

Remember that we will give methods of improvement to all our members desiring them.

If you are interested in such an association as ours and live where there are less than fifteen engineers located, send for our prospectus and a constitution and apply for admission to the nearest lodge. If you live in a town where there are fifteen or more engineers, get together and send in a written application for a charter.

The engineer of to-day, if he is a progressive one, is much interested in securing the passage of laws which compel the engineer to give evidence of his fitness to act as such.

W. A. CROCKETT
Executive Secretary
MT. HAMILTON - ONT.

DRAINING POWER HOUSE STEAM LINES

with a

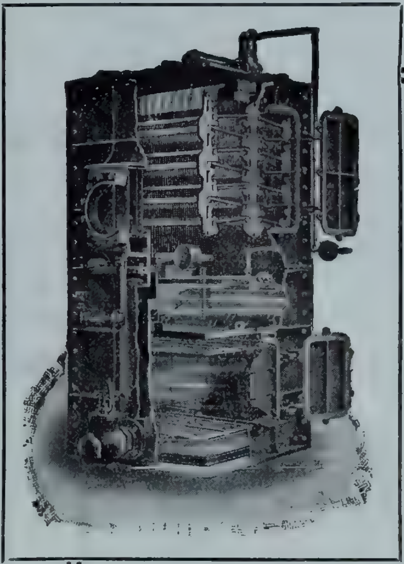
MOREHEAD STEAM TRAP

THERE is no service requiring the removal of condensation from Steam lines too difficult or exacting for a Morehead Trap to handle. The illustration shows a Morehead Trap in service in the Power House of the Western Electric Company at Hawthorne, Ill. For efficient, reliable, high class service—

Specify a "Morehead"

A postal brings our "Trap Book."

MOREHEAD MFG. CO.
Dept. "E" DETROIT, MICH.



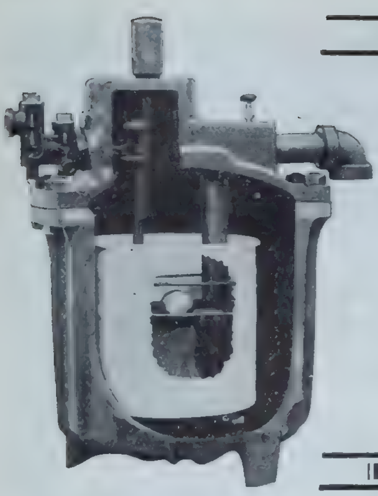
More Work
for
Less Cost

Any proposition that will diminish working costs MUST appeal to every shop owner. Have you investigated the

Webster Feedwater Heater, Purifier and Filter?

It makes use of all condensations and waste steam, and will positively rid your boiler of scale by removing scale-forming elements from feedwater. Using pure water means getting every ounce of power out of your boiler, with a SMALLER amount of fuel Our descriptive literature is full of points for you. Send for it to-day.

DARLING BROS., LIMITED
Montreal Toronto Winnipeg
Vancouver, B.C., Frank Darling, Agent



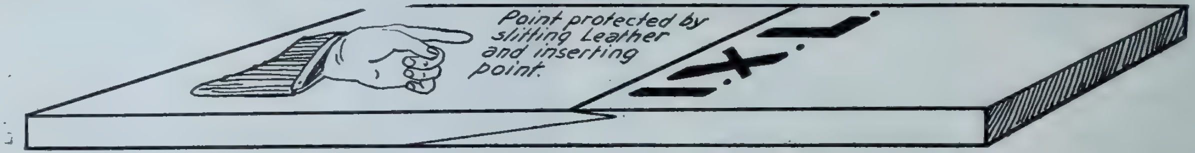
THE ALBANY
STEAM TRAP

Will solve the problem for you. Backed by over 40 years' trap experience. Get in touch with the makers:---

The Albany Steam Trap Co.
ALBANY, N.Y.

THE "I.X.L." SPLICE

"THE BELTING SPLICE THAT WILL NEVER COME OPEN"



The great trouble with *any* belting—no matter how good the leather—that is joined up with the ordinary splice, is the fact that the splices come open, causing loss and delay. J. D. McArthur's Leather Belting made with the "I.X.L." SPLICE, as shown in this cut, *cannot* come open at the splices. Note the protected point, outside point running same direction as pulley.

J. D. McArthur's Leather Belting is made from Prime British Oak-Tanned Leather, from Close-Trimmed Backs exclusively.

Write for our complete price list. **J. D. McARTHUR & CO., Brockville, Ontario**

Stock at Toronto Branch 639 King St. East; J. E. Stephenson & Co., Agents

---

Approaching the Ideal!

THE
Duffy Steam Trap

is nearer the ideal sought after by engineers than any other trap on the market. Its distinctive and controlling feature lies in the expansion and contraction of iron pipe in coil, as shown in cut. It possesses large draining capacity, and will drain system when steam is shut off, thus preventing danger from frost. May we prove our claims? We will send a DUFFY TRAP to any responsible party on

30 DAYS' FREE TRIAL. ***Write for one to-day.***

FRANCIS DUFFY, 136 Stuart Street, KINGSTON, ONT.

THE FLINN STEAM TRAP

A Differential Trap

With Only Three Moving Parts

There are no buckets, no floats, no joints to pack, **and** there is no trouble.

It is a trap that can be recommended for almost any and every class of work, because it is the only steam trap on the market that embodies such simplicity with such a wide range of possible adaptions.

It will work equally well at any pressure from 1 to 300 pounds and **in any position** over 45 degrees. Vibration of buildings or the tossing of vessels has no effect upon it.

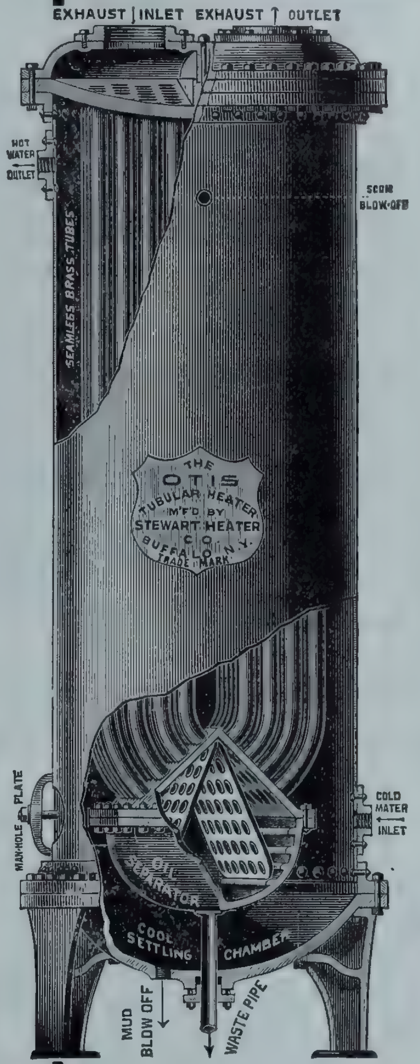
Besides its inherent advantages, every trap is sold under a positive guarantee which is a safeguard to the buyer.

Write for further particulars.

Richard J. Flinn
WEST ROXBURY - MASS.
CANADIAN AGENTS :
THE POWER ECONOMY CO. - Montreal

Practise Economy

by utilizing your exhaust steam to heat your Feed Water to the boiling point, without any back pressure. You can do this if you will install an



OTIS

Tubular Feed-Water Heater, Oil Separator and Purifier

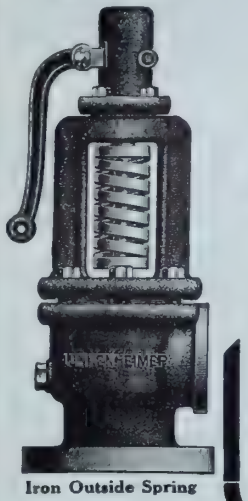
You have our unconditional guarantee that the "OTIS" will do this for you, and it will moreover extract the oil from the exhaust so that the steam, after being passed through the heater, can be used for other heating purposes.

Water of condensation can be returned from the heating system to the boiler without the additional expense of an eliminator.

Will you allow us to 'make good' our claims ? We will pay all costs of a trial of the "OTIS" if not found as represented. Send your request along TO-DAY for catalogues and prices.

The STEWART HEATER CO.
189 Norfolk Avenue, - Buffalo, N.Y.

Brass Top Outlet Encased Spring



Iron Outside Spring

THE OBJECT

of a safety valve is to RELIEVE AN EXCESS OF PRESSURE, BUT NO MORE, and one that does relieve more is wasteful and expensive. Neither is a valve with excessive lift needed nor is it desirable because it is not durable, as it causes a tremendous wear on the seating surfaces.

Lunkenheimer Pop-Safety Valves

will PROMPTLY RELIEVE THE OVER PRESSURE ONLY, and nothing more. They can be regulated to reduce the pressure only one pound, if such close regulation is desired; will not chatter or hammer themselves to pieces, will not stick, and adjustment of the pop and pressure can be made from the outside of the valve.

The valves can be had with either brass or iron bodies, made in all standard sizes and are guaranteed for working pressures up to 250 pounds.

Lunkenheimer Line of Pop-Safety Valves

is a very large and complete one and is thoroughly illustrated and described in our catalogue, a copy of which will be sent free upon request.

"Most supply houses sell them—yours CAN—if they DONT or WONT, tell US."

THE LUNKENHEIMER COMPANY

Largest Manufacturers of high-grade Engineering Specialties in the world

General Offices and Works

CINCINNATI, OHIO, U.S.A.

CHICAGO, 32 Dearborn St., Cor. Lake —BRANCHES— NEW YORK, 66-68 Fulton Street

LONDON, S.E., 35 Great Dover Street.

41

Iron Encased Spring

Brass Outside Spring

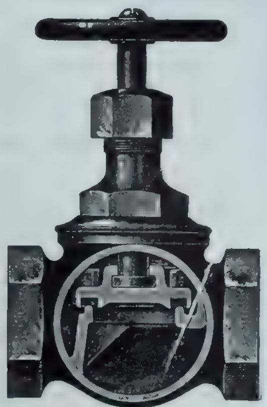
The Measure of Success

of any valve is it ability to STAY TIGHT.

FAIRBANKS VALVES

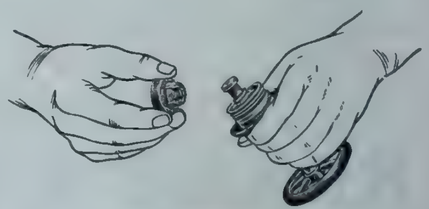
are tight and stay tight under the most severe conditions. The disc is loose on the spindle, allowing it to come to an even bearing on the seat. The use of our composition ring which is spun in the disc enables us to use a rounded seat as shown, which affords less surface than a wide, flat seat for the lodging of scale, chips, etc. Any that do lodge become embedded in the elastic disc without destroying the valve seat. The valve is doubly strong, owing to proper distribution of metal.

These points all count after the valve has been in service, and mean the difference between a leaky, wasteful valve and a Fairbanks Economical Valve.



Fairbanks Valves---All sizes---for every requirement

By removing the bonnet of the valve as shown and inserting one of our brass discs with composition ring, the valve is made as good as new.



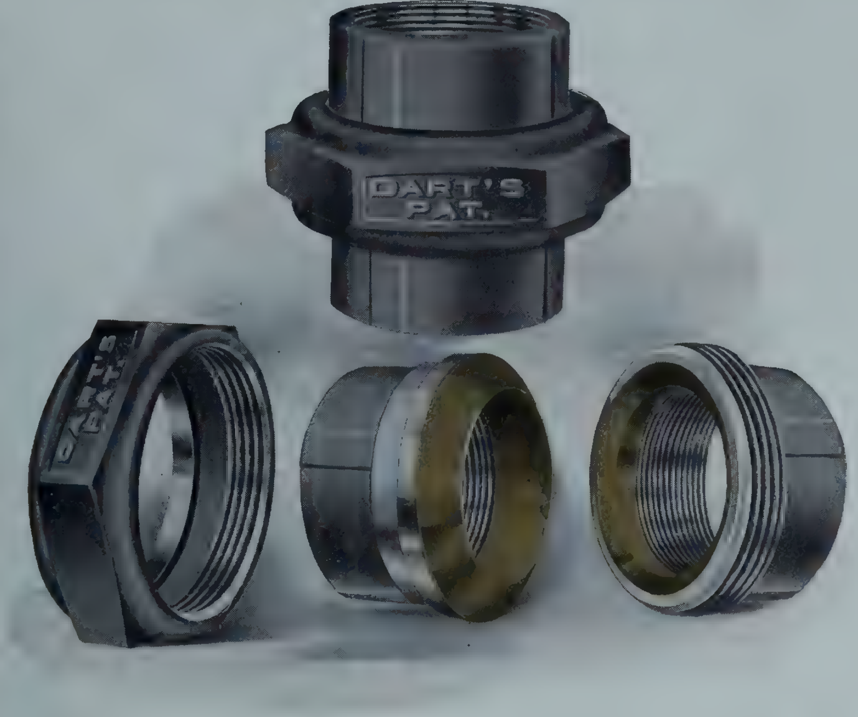
The Canadian Fairbanks Co. Limited

Fairbanks Scales---Fairbanks-Morse
Gasoline Engines, Safes and Vaults

Montreal Toronto St. John, N.B. Winnipeg Calgary Vancouver

A Ground Ball Joint --- Bronze to Bronze

Heavy Iron Ends --- Clean, Full Standard Threads.



The Dart Screwed Union, for pipe up to 2½ inches.

In a nutshell that describes the construction of

Dart Unions

With Dart Unions, absolutely tight joints can be made quickly and without trouble—even if the pipes are out of alignment.

Dart Union joints do not leak; cannot rust or corrode at the joint, and may be joined time after time without affecting the life of the union.

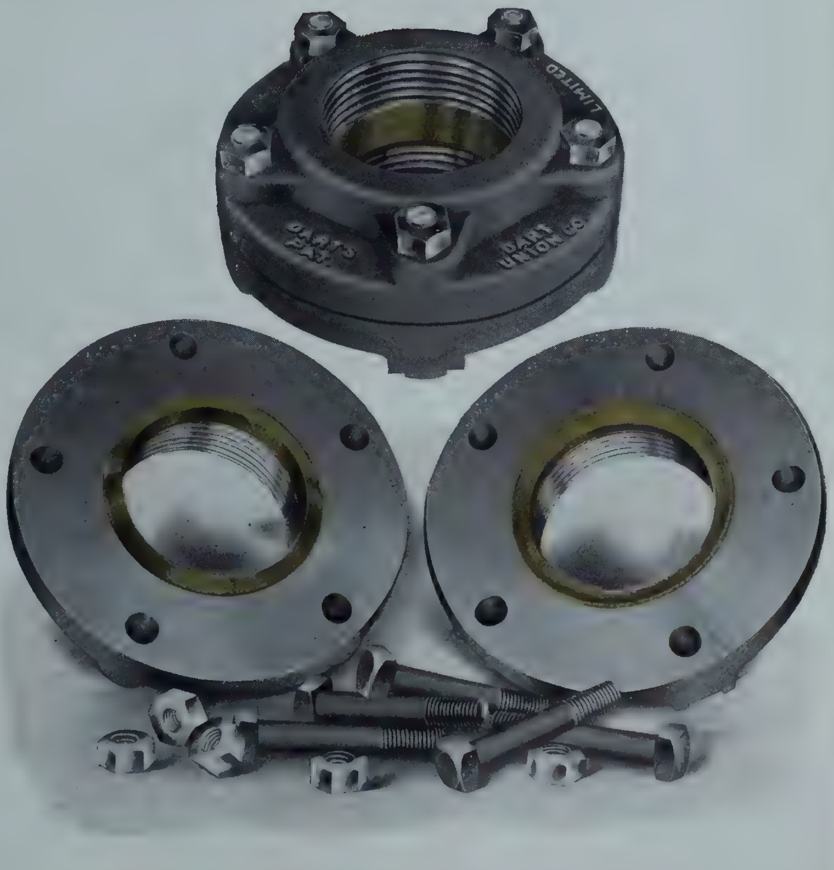
When you **think of it** Dart Unions are the only kind worth your while; because, once made, a Dart Union joint is always absolutely tight.

Make the joint—then forget it.

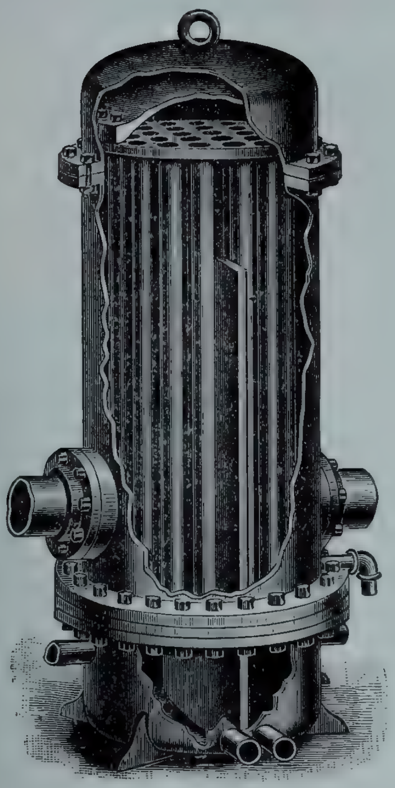
ALL DEALERS:

Remember, Dart Unions have Bronze to Bronze joints, and the name "Dart" cast on them.

Dart Union
Company, Limited
TORONTO, - ONT.



The Dart Flange Union, for 2½ inch pipe and larger.



The Jacobs Feed Water Heater

Combines in itself all the qualities of a simple, effective and well constructed apparatus built on thoroughly mechanical lines

It is constructed of cast iron—fully machined at every joint. The tubes are drawn brass and are arranged to allow for expansion – the top header being free to move see cut. This simple heater will outlast your boilers and will not bother you with heater troubles.

IT IS FULLY GUARANTEED

Chas. J. Jacobs & Co.

42 OLIVER STREET **Boston, Mass.**

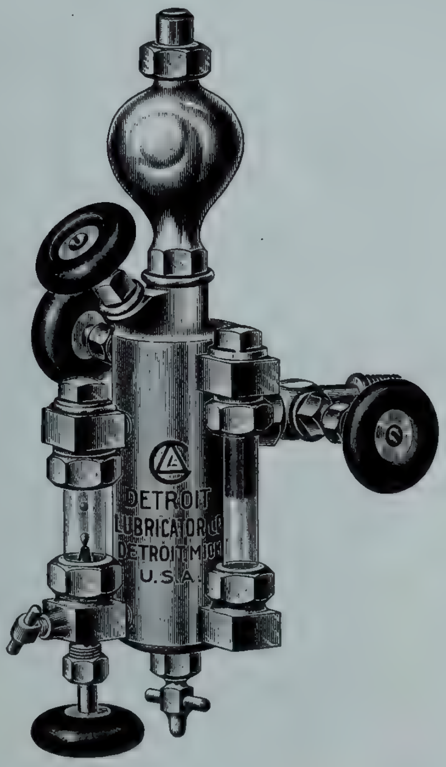
Genuine "Detroit"-Improved Standard Lubricator

Simple in theory.

All that skill and money can produce in construction.

Dependable in practice.

Every "Detroit" Lubricator is carefully inspected before shipping.



Send for Catalog A58 Illustrating 339 Types-Sizes

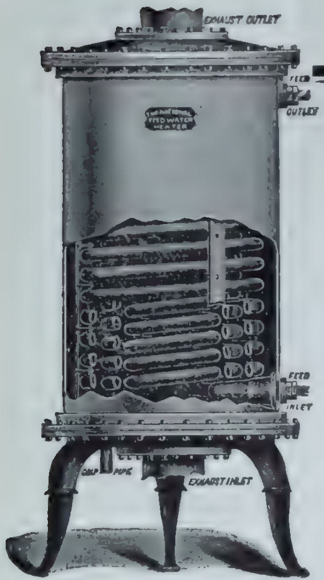
The first "Sight Feed" Lubricator was originated by the Detroit Lubricator Co. over thirty years ago.

To-day we operate the largest plant devoted to the manufacture of Lubricating Devices in the World.

Be sure you get the Genuine "Detroit".

DETROIT LUBRICATOR COMPANY.

DETROIT, U.S.A.



The National Feed Water Heater

unlike other heaters, permits no contact of water with the shell, and obviates back pressure, because its shell area is six times that of its exhaust pipe. It has no straight tubes or inside joints and rarely costs anything for repairs.

From 1 to 14 coils of SEAMLESS DRAWN brass or copper tubing are encased in a cast iron or steel shell to which exhaust steam is admitted, heating the water passing through the tubing.

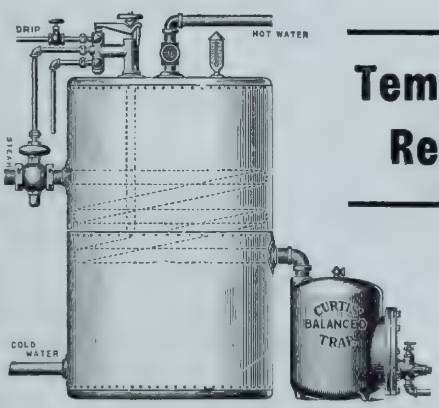
If you are interested in the Feed Water Heating Problem, send for our book on the subject FREE.

The National Pipe Bending Co.

91 Lloyd Street, New Haven, Conn., U.S.A.

Curtis Engineering Specialties

Temperature Regulator



For controlling the temperature of hot water in hotels, hospitals, etc.

Send for circular and 1910 catalogue

JULIAN D'ESTE COMPANY

24 Canal Street, - Boston, Mass.

KERR GATE VALVES

are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

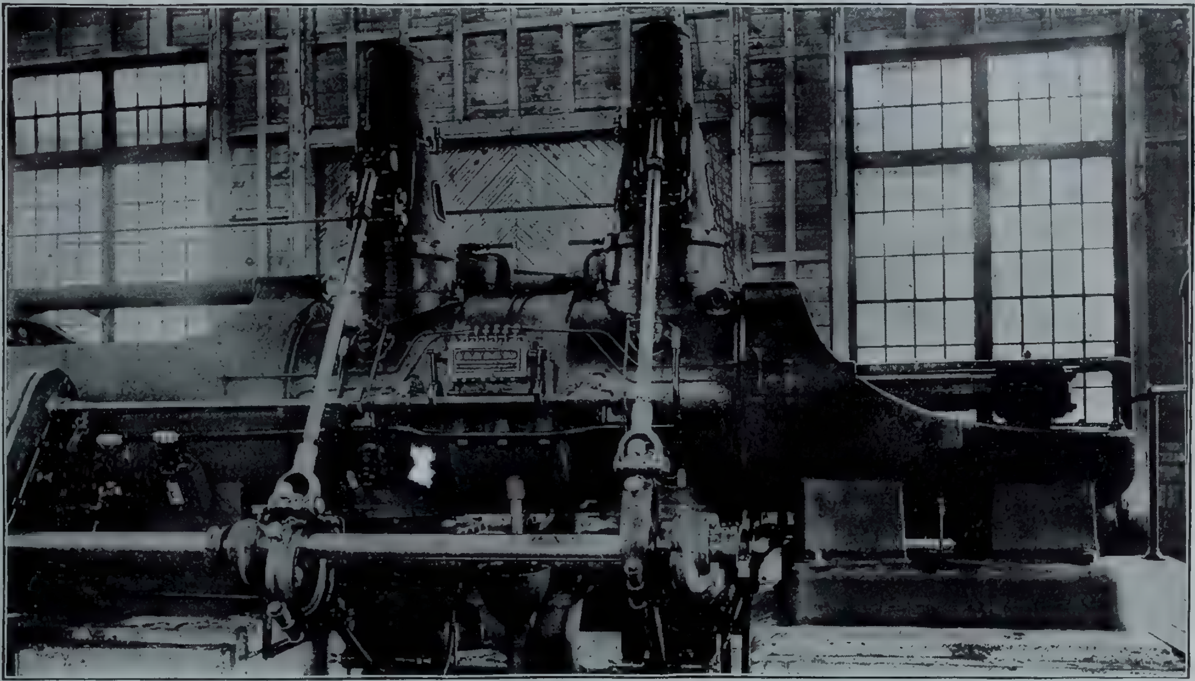
Write for our Catalog of High Grade Brass and Iron Valves.

The Kerr Engine Co., Limited

Valve Manufacturers

Walkerville, - Ontario

GAS ENGINE CYLINDER LUBRICATION



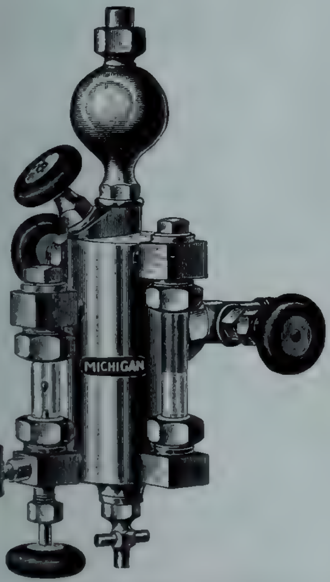
For double acting gas engine service the special model M. pumps have proven efficient and economical. We have had several years of success in this field and our engineering department will take pleasure in going over this proposition with you. Over 1300 cylinder feeds of this kind in one plant. Bulletin 209 L. describes this model fully.

Manufactured by the SIGHT FEED OIL PUMP CO., MILWAUKEE, WIS.

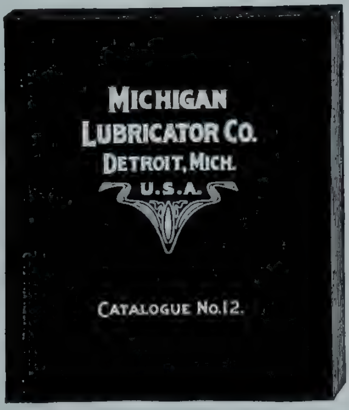
PLEASE CONSULT OUR CANADIAN REPRESENTATIVES, MESSRS. WILLIAMS & WILSON, MONTREAL, CANADA.

MICHIGAN

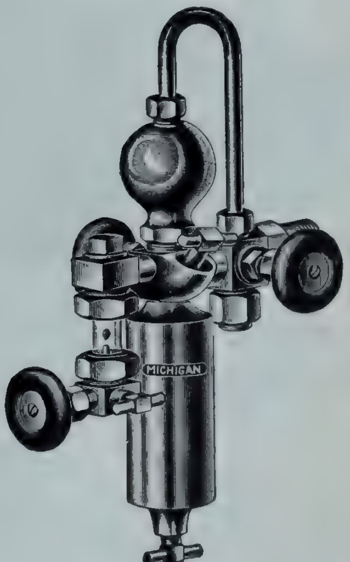
Illustrated catalog mailed to you free



Improved Double Connection.



WRITE TO-DAY

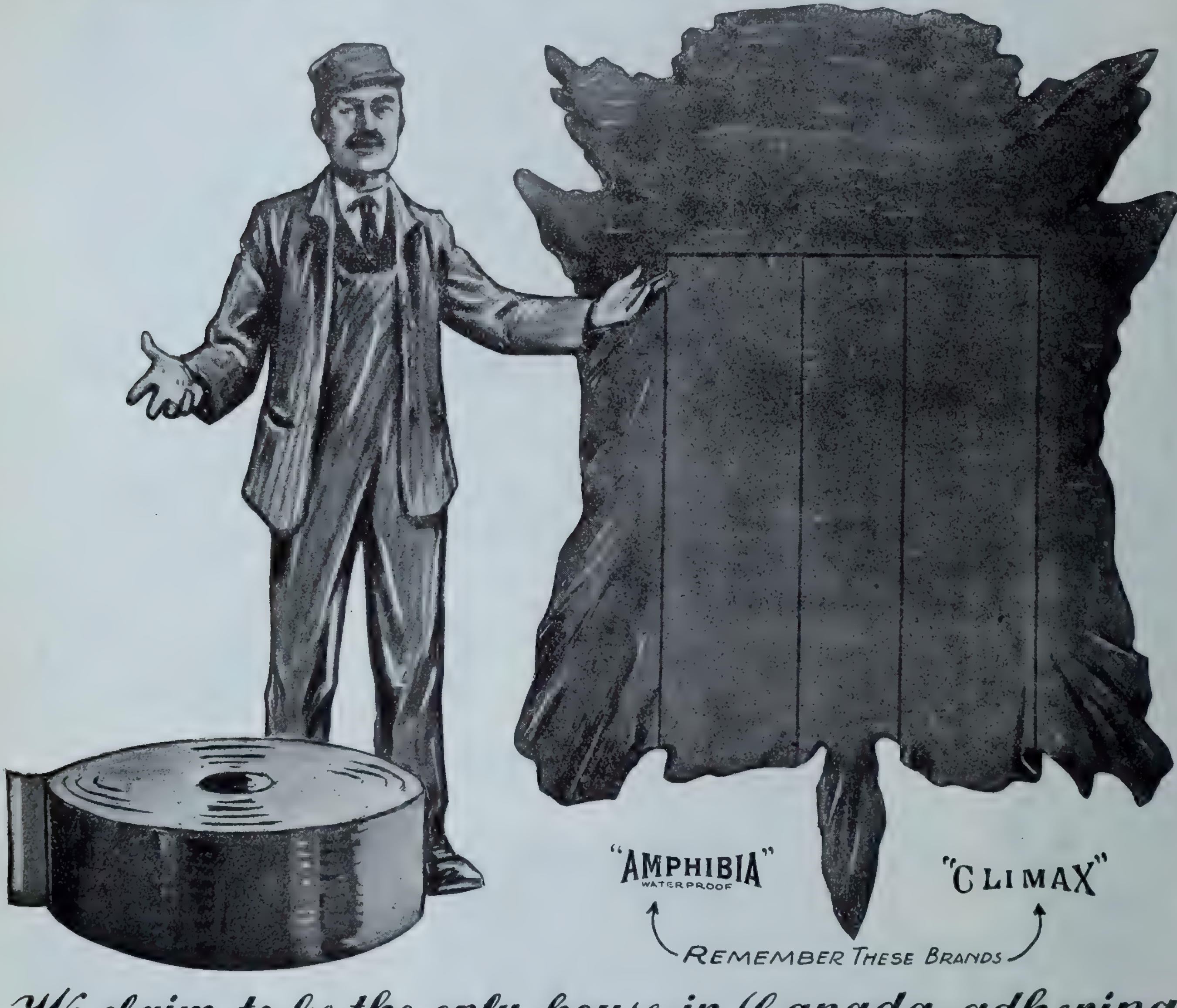


Improved Single Connection.

MICHIGAN LUBRICATOR CO.

DETROIT, MICH.

The only part of the hide used in Sadler & Haworth Belting is that shown within the solid lines marked on this diagram. That is the toughest and best portion and the only part the strength of which is absolutely reliable.



We claim to be the only house in Canada adhering strictly to this method of cutting belt leather

Have you got our Price List?
Write us for a copy

Full stock carried at
511 William Street, Montreal
89 Prince William St., St. John, N.B.

Sadler & Haworth

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217 Columbia Ave., Vancouver
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Do Your BELTING TROUBLES weigh heavily on your shoulders?

There is one sure way of preventing stoppages and breakdowns! Get into line with the wise engineers and install

D. K. McLAREN'S

GENUINE BRITISH OAK TANNED

LEATHER BELTING

Our Belting is made exclusively from closely-trimmed centres of the very highest quality hides. Our Tanning Process is the genuine British ***OAK*** Method—not to be confused with inferior hemlock processes to which the name "Oak Tanning" is frequently and wrongfully given. Our regular lines are EXTRA "C" and "STANDARD "B."

The best on earth for all general purposes. Write for price lists.

D. K. McLAREN, Limited

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64 Prince William Street

VANCOUVER, B.C.
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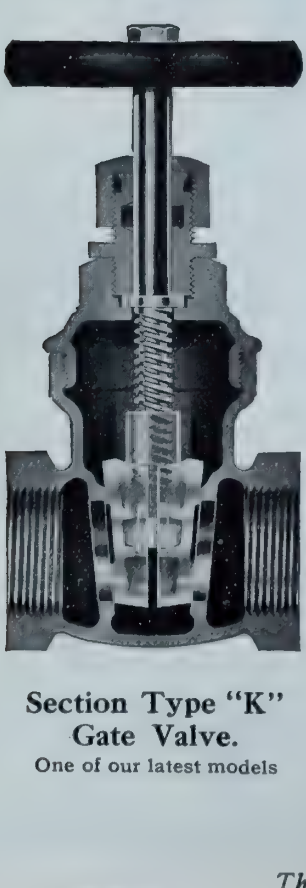
JENKINS

ARE

See our Exhibit at the
C.A.S.E. Convention

in Berlin this month and you can easily find out JUST WHY our valves back up our claims that they ARE the best---by test, design, material and workmanship.



Section Type "K"
Gate Valve.
One of our latest models

JENKINS BR

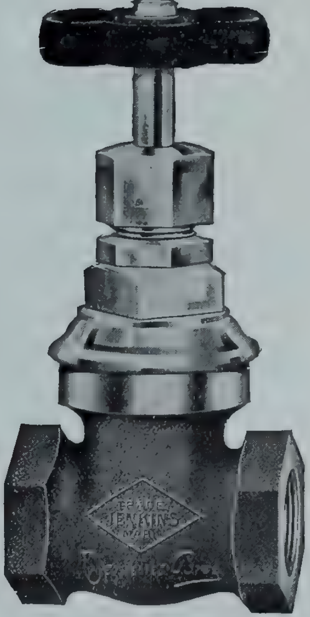
MONT
102 St. Re

BROS' VALVES

BEST

Call on us at our Factory and let us show you

the ways and means we take to safeguard against the shipment of any valve that would reflect on our reputation as the makers of the best valves. Let us show you the care exercised in the fitting and assembling of parts. Let us show you the BEST valve.



Type "K" Gate Valve

Outside View

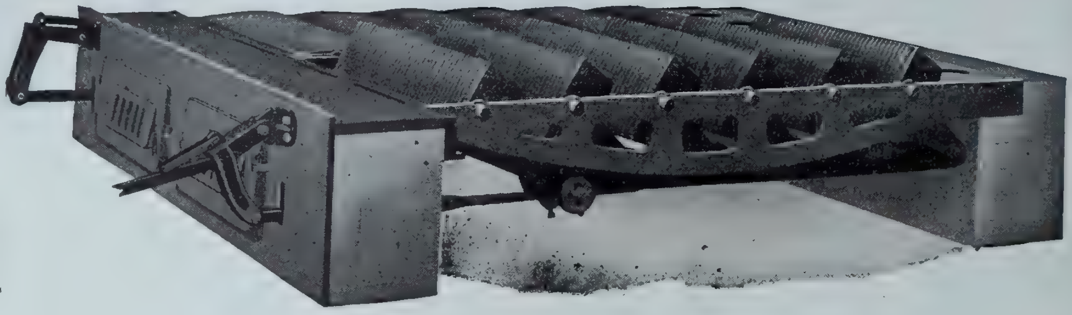
OS., LIMITED

REAL

mi Street

THE DIAMOND SHAKING AND DUMPING GRATE BAR

Diamond grates increase your power from 5-20 per cent.



Besides reducing your coal bill from 5-25 per cent.

Canadian Patent 118778

The Diamond Grate has no Equal as to Simplicity and Durabilty

When you place the DIAMOMD Bar under your boiler you can be assured that you have the most DOWN-TO-THE-MINUTE Shaking and Dumping Grate Bar on the market, EXCEPTING NONE.

Reasons Why

1st—The Diamond weighs more per square foot than any other and has its weight so distributed that there is no weakness. HENCE WILL LAST LONGER.

2nd—The clips or spans in the Diamond are so constructed that the air passing through is distributed evenly and not in certain places only. THEREFORE ASSURING BETTER COMBUSTION.

3rd—The Diamond Bar allows the air to expand immediately after it passes the air line, thus reaching a much larger percentage of coal than the grates with the dead flat surfaces. HENCE LESS CLINKERS.

When at the C.A.S.E. Convention tell us your troubles—we can help you out. We set and repair Boilers.

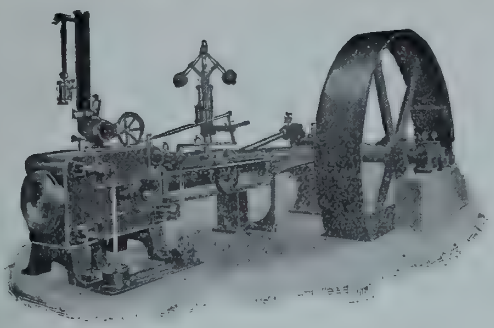
WE INSTAL THE DIAMOND ON APPROVAL, and unless we can show you, we will take same out without one dollar expense to you.

Drop us a line and get our proposition.

The Diamond Grate Bar Company

134 King W., Berlin, Ontario

Phone 34 A or B.



Girder Bed Corliss Engine

Catalog on application

ESTABLISHED 1867

The VILTER MFG. CO.

242 Becher Street Milwaukee, Wis., U.S.A.

BUILDERS OF HIGH-GRADE

CORLISS ENGINES

Simple or Compound, Girder or Heavy Duty Bed. Any size, 30 to 1,000 H.P.

Ice and Refrigerating Machinery

THE LINDE {AMMONIA and CARBONIC ACID} SYSTEMS

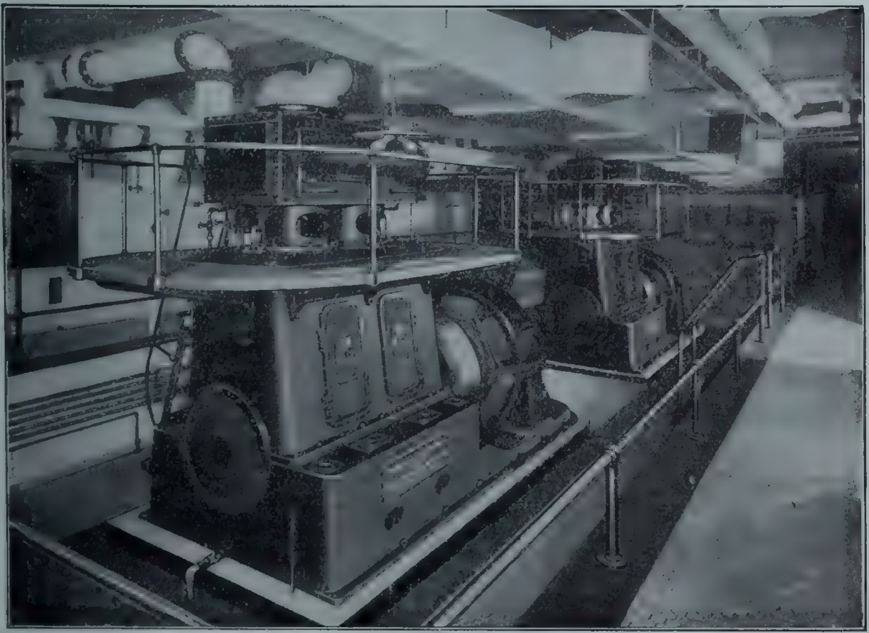
For Cold Storage and Ice Making Plants

Patent Seamless CORK INSULATION—Efficiency With Economy

Send for our catalogue showing details of installations and containing many useful tables and other data concerning this industry.

The Linde British Refrigeration Co., Limited - Montreal

COMPLETE PLANTS DESIGNED AND INSTALLED



Has Cost Nothing for Repairs

A customer says:—

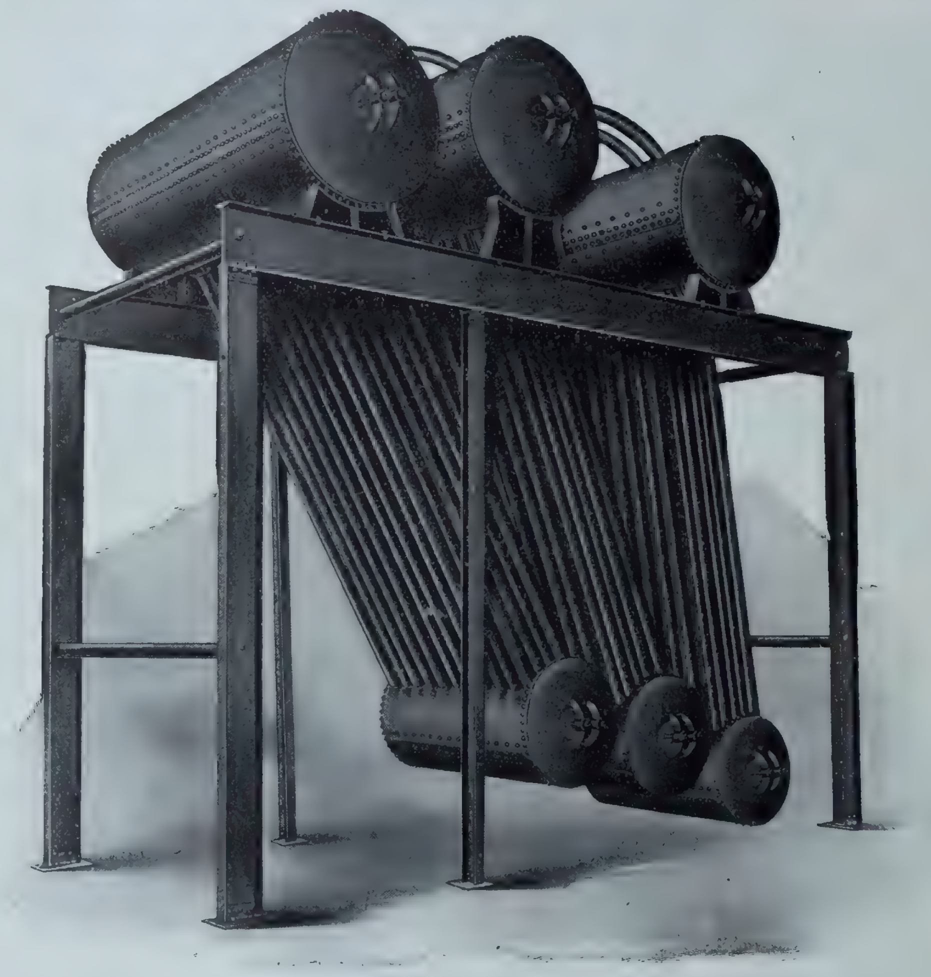
"We have used one of your vertical high speed engines, English type, forced lubrication, since 1907. The engine runs at 425 revolutions per minute almost constantly night and day. It has given us every satisfaction and so far has cost us nothing for repairs."

Robb Engineering Co., Ltd., Amherst, N.S.

DISTRICT OFFICES:
607 Canadian Express Building, MONTREAL; R. W. Robb, Manager
Traders Bank Building, TORONTO; Wm. McKay, Manager
Union Bank Building, WINNIPEG; W. F. Porter, Manager
609 Grain Exchange Bldg., CALGARY; J. F. Porter, Manager

Water Tube Boilers

Return Tubular, Horizontal Marine, Vertical and Portable Boilers, with or without Wheels



Side View of our NEW WATER TUBE BOILER. Not bricked in.

Our Engines, Boilers, Heaters, Pumps and Condensers are Prominent in Canada's Largest Power Houses.

The Goldie & McCulloch Co., Ltd.

Galt, Ontario, Canada

WESTERN BRANCH	QUEBEC AGENTS	BRITISH COLUMBIA AGENTS
248 McDermott Ave., Winnipeg, Man.	Ross & Greig, Montreal, Que.	Robt. Hamilton & Co., Vancouver, B.C

WE MAKE Wheelock Engines, Corliss Engines, Ideal Engines, Piston Valve Saw Mill Engines, Gas Engines and Producers, Boilers, Heaters, Steam and Power Pumps, Condensers, Flour Mill Machinery, Oatmeal Mill Machinery, Wood-Working Machinery, Transmission and Elevating Machinery, Safes, Vaults and Vault Doors.

Ask for Catalogues, Prices and All Information.

Stationary Engineers' Annual Convention at Berlin

Twenty-first Annual Convention—Program of Convention—Exhibition of Power Supplies—Papers to be Read—Smoker, etc.—Cheap Rates.

It was a happy choice when the C. A. S. E. chose Berlin as the place of convention for 1910. It is the centre of a large manufacturing district, being itself a manufacturing city of about 14,000 inhabitants.

W. C. McGHIE, TORONTO,
Past President, C.A.S.E.

CHAS. KELLY, CHATHAM,
Executive President C.A.S.E.

Such utilities as the water works, sewage disposal plant, gas and electric light plants and street railway system are all owned and operated by the town itself. These respective services, in consequence, are most efficient and are conducted with a keen eye to the health, to the comfort and to the reduction of the living expenses of each and every home.

Berlin was 100 years old in 1906. It is said that this agressive community owes its beginning to a camp fire lit by pioneers from Philadelphia in 1906.

Though the foundation of Berlin was well and truly laid one hundred years ago, the commercial structure reared upon it, dates back scarcely more than twenty-five years. Then it was that its leaders adopted a factory policy and tried their strength in the manufacturing field, with considerable success, Berlin to-day possesses seventy-five industries, all worthy of note and a considerable number of national reputation.

Having no natural advantages to speak of, and yet having outstripped communities which possess them, the general public will desire to know the underlying causes of Berlin's progress. These may, fairly, be ascribed to certain qualities possessed by its people. Of late years numerous municipalities have evidenced a communal spirit of progressiveness. This has been at work in Berlin for a quarter of a century. They engaged in every line of manufacturing which they believed they could make and make well. They struggled and persisted, displaying that rare courage which believes difficulties are made to be surmounted. There was no turning back. The goal must be reached and reach it they did. In those trying early years, the predominating traits of the German character stood them well: Industry without measure; a thoroughness that led them to exhaust every subject necessary to be mastered; and the sheet anchor of thrift. Add, a love of home and Berlin and you have the groundwork on which the town's success rests.

Berlin has contracted with the Hydro-Electric Commission for 1,000 h.p. at $24. The line and transformer station has been completed and Berlin will be the first town to receive power over the Hydro-Electric Commission's line.

Cheap Fares to Berlin.

Arrangements have been made so that all engineers may easily visit Berlin during the convention and see first hand the large exhibit of power plant equipment. Secure a one-way ticket to Berlin and get from the ticket agent a standard convention certificate. Present this to J. B. Goff, secretary of the Exhibitors' Association, on Wednesday morning, July 27. The exhibit will be open Tuesday, Wednesday and Thursday, July 26, 27 and 28 during the three days of the convention.

W. A. CROCKETT, MOUNT HAMILTON,
Executive Secretary C.A.S.E.

Programme.

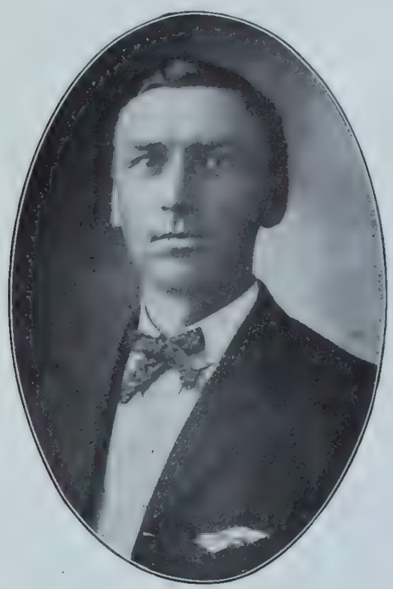
Herewith is giving the programme for the convention. The social features are the banquet Monday evening, followed by a theatre entertainment, the sports Wednesday afternoon at Victoria Park and the smoker Wednesday evening.

A. M. WICKENS, TORONTO,
Executive Treasurer C.A.S.E.

At the smoker there will be papers read on subjects of interest to every engineer. The papers will be contributed by A. W. Spotton, Goldie & McCulloch, Galt; A. M. Wickens, Toronto, and H. L. Peiler, of Peiler & McKenzie, Montreal.

Executive Officers.

The following engineers hold the executive offices for the year and have carried on the work of the association successfully:



J. J. HEEG, GUELPH,
Executive Vice-President C.A.S.E.

Past Pres.—W. C. McGhie, Toronto.
President.—Chas. Kelly, Chatham.
Vice Pres.—J. J. Heeg, Guelph.
Secretary—W. A. Crockett, Mount Hamilton.

W. H. BRADT, WINDSOR,
Executive Doorkeeper, C.A.S.E.

Treasurer—A. M. Wickens, Toronto.
Conductor—W. Norris, Chatham.
Doorkeeper—W. H. Bradt, Windsor.

C. A. S. E. Exhibitors' Association.

The officers in charge of the 1910 exhibition are as fallows:

President—W. R. Stavert, Jenkins Bros., Montreal.

First Vice-President—G. E. Fisher, Canadian Fairbanks, London.

Second Vice President—E. A. Hethrington, Goldie & McCulloch, Gaft.

Treasurer—H. C. Austen, Dunlop Tire & Rubber Goods Co., Toronto.

Secretary—J. B. Goff, Dart Union Co., Toronto.

Assistant Secretary—G. C. Keith, editor of The Power House, Toronto.

The executive consists of the above officers.

The following companies will be represented at exhibition, Dunlop Tire & Rubber Goods Co., Toronto; Goldie & McCulloch, Galt; Dart Union Co., Bice Regulator Co., London; Peiler & McKenzie, Montreal; Diamond Grate Bar Co., Berlin; Jenkins Bros., Montreal; Canadian Fairbanks Co., Montreal, Lunkenheimer Co., Cincinnati; Dearborn Drug & Chemical Co., Chicago; Cling Surface Co., Buffalo; Canadian Steam Boiler & Equipment Co., Toronto; Francis Duffy, Kingston; Quaker City Rubber Co., Pittsburg; Strong, Carlisle & Hammond Co., Cleveland; Twin City Oil Co., Berlin; Canadian Manufacturing, Toronto; Power, New York, and The Power House, Toronto.

BERLIN'S MUNICIPAL POWER PLANT.

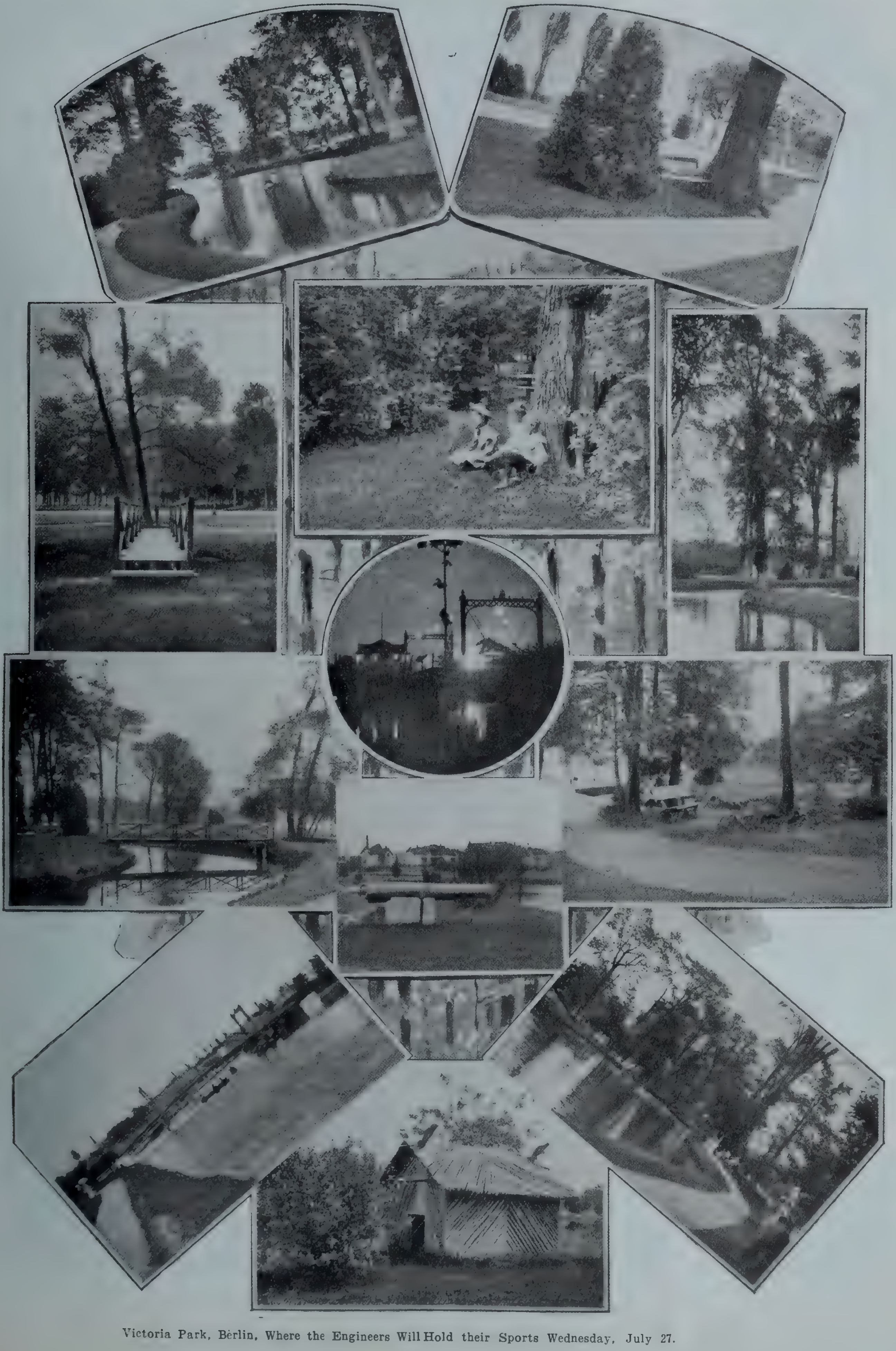
Berlin has a large municipal power plant consisting of one 250 h.p. Westinghouse gas engine, three 90 h.p. and one 70 h.p. The gas is produced in two R. D. Wood producers and there are the necessary scrubbers, purifiers, etc. As an auxiliary there are two Goldie & McCulloch 80 h.p. return tubular boilers and a 100 h.p. steam engine built by the Waterous Engine Works, Brantford.

The Berlin plant was designed by R. D. Wood, Philadelphia, manufacturers of gas producer. One of the illustrations shows a Wood producer in section. This instalation consists of a No. 8 Wood producer followed in order by an economizer and scrubber and a gas purifier, which is connected to the gas holder. Between the different elements of the plant are suitable connections for gas, water and steam. There is an overhead coal bin served by a link belt elevator which carries the coal from the elevator boot near the base of the producers to a point from which gravity discharges it through a spout to the receiving magazine to the automatic feed. The automatic feed distributes the coal continuously and uniformly over the entire surface of the fuel bed. In this way labor is largely eliminated in the transfering of fuel from the storage bin to its withdrawal as ashes from the base of the producer.

W. NORRIS, CHATHAM,
Executive Conductor, C.A.S.E.

The gases leaving the producer enter the super-heater and economizer, through which latter attachment the air blast of the producer travels in the reverse direction to the Korting blower. Passing through the wash-box, the gas largely deposits its extraneous matter. Here also is arranged a seal against the gases stored in the holder and present in the rest of the apparatus. Entering the scrubbers, whose compartments are filled with coke and showered by water sprays, it is still further purified of any tarry matter, sulphur ciently completed in the purifier, the or ammonia, which operation is suffi- next and last element of the plant, before reaching the holder. In the holder

PETER UTTLEY,
President Berlin Lodge C.A.S.E.



Victoria Park, Berlin, Where the Engineers Will Hold their Sports Wednesday, July 27.

E. C. FITZGERALD,
Hon. Pres. C.A.S.E. Exhibiters' Association.

W. R. STAVERT, MONTREAL,
President Exhibitors' Association.

GEORGE FISHER, LONDON,
Vice-President Exhibitors' Association.

is stored a sufficient supply to start and for several minutes' run, but it serves mainly as a regulator of pressures and cares for variations in consumption and mixture of gases. Drip pots and drainage pipes, minor but very essential parts, are placed suitably, while the hot water from the producer tops is carried to the holder tank.

Producer.

As shown in the illustration the producer consists of an upper and lower cylindrical casing, each of sheet steel plates and meeting in a joint about one-third the height of the producer.

Upon brackets at the top of the lower casing is placed a cast-iron mantle ring which supports the brick lining, and from its inner edge depends a circle of segmental perforated bosh plates. These latter are bolted together to form the ash-enclosing bosh. Beneath the bosh plates and supported at a fixed distance from their lower edge is the rotative ash table. Upon this rests the column of fuel and ash, the whole being carried upon heavy cast-iron beams riveted to the lower casing. A cast-iron bearing plate is bolted to the supporting beams and upon it roll the balls which are confined in runways provided in the lower side of the rotative ash table. The table is revolved by means of a rack under the table, engaging with a pinion on a shaft driven by hand or power gearing substantially attached to the outside of the lower casing. Suitable guides hold the table centrally.

The upper portion of the central blast pipe is bolted to the revolving table, and with its rigidly attached hood turns with the table. The lower section of the blast pipe is attached to the blast box imbedded in the foundation, and is capped by a

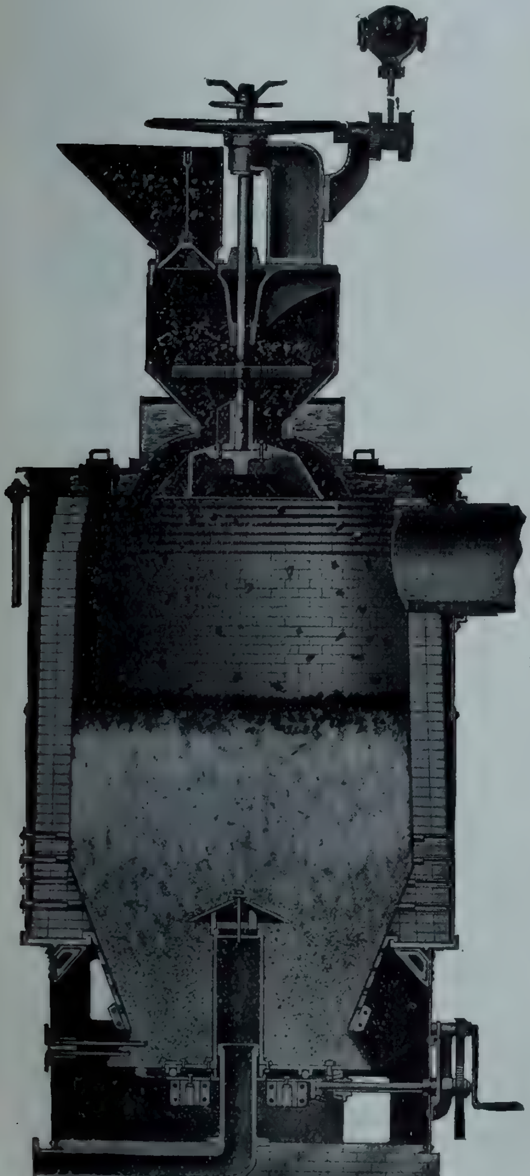
EARL HETHRINGTON, GALT,
Vice-president Exhibitors' Association.

JOHN B. GOFF, TORONTO,
Secretary Exhibitors' Association.

GORDON C. KEITH, TORONTO,
Assistant Secretary and Auditor Exhibitors' Association.

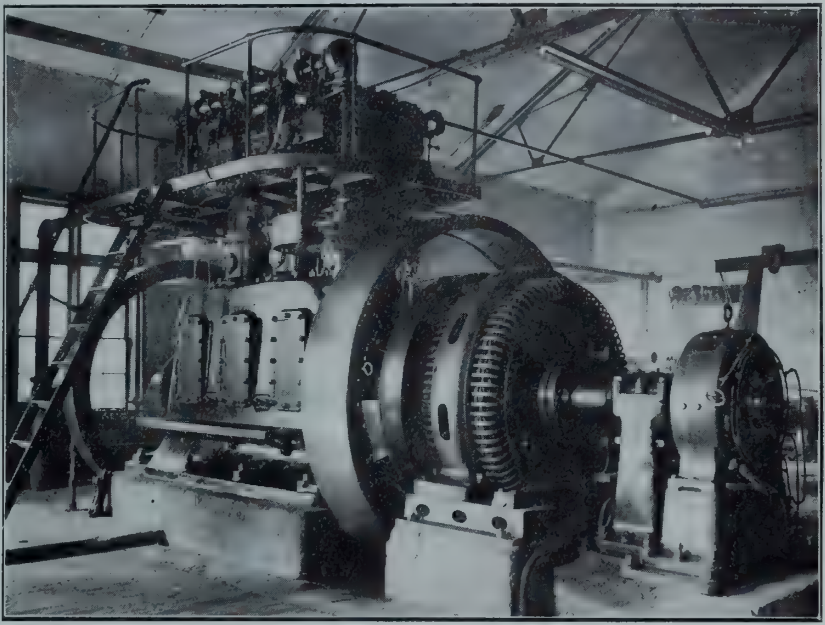
H. C. AUSTEN, TORONTO,
Treasurer Exhibitors' Association.

loose filling-in collar. The injector blast blower is attached to the outer end of the blast box. Four sets of scraper bars are placed to extend into the space between the table and lower edge of the bosh plates. Their projection is adjustable, reaching the ash bed or not as desired. The lower casing is provided in its upper part with observation doors, permitting inspection or insertion of poking bars through the perforations of the bosh plates. Two ash-pit doors for removal of ash are at the base of the producer. In the lower part of the top casing there are placed on the quarters a vertical row of four sight holes to observe the location of the fire line or height of the ash bed.

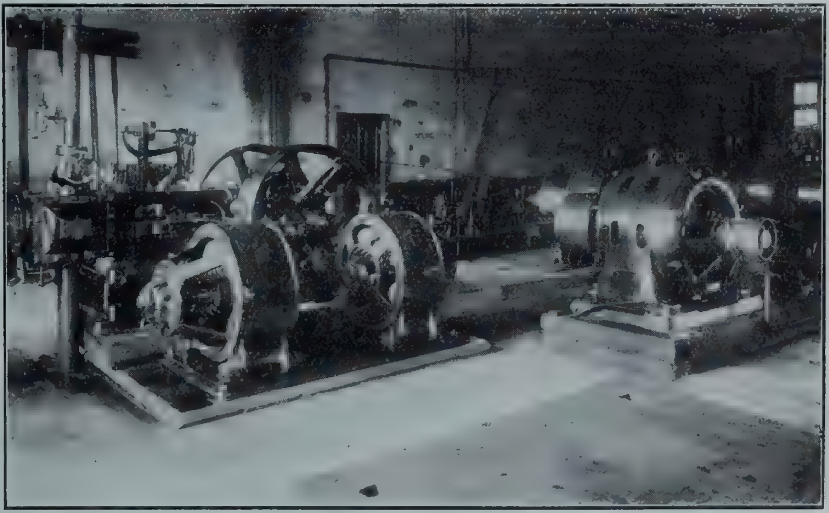

Section of Gas Producer, R. D. Wood & Co., Philadelphia.

The top is water cooled and otherwise constructed as described for the water-sealed producer.

It will be noticed that the revolving table is of greater diameter than the bottom of the bosh, and is placed at such a distance therefrom that when it is revolved the ash, which forms its own slope at an angle of about 55 deg. is discharged uniformly by its own gravitation over the periphery and into the sealed ash pit below (which is under blast pressure), all without stopping the producer and with little interference with the making of gas.


Berlin Gas Producer Power Plant, Showing Westinghouse 250 h.p. Gas Engine.

The central blast pipe is placed with its top at a point sufficiently high to carry the required bed of ashes, the top of which should never be brought as low as the top of this central air pipe.


Berlin Gas Producer Power Plant.

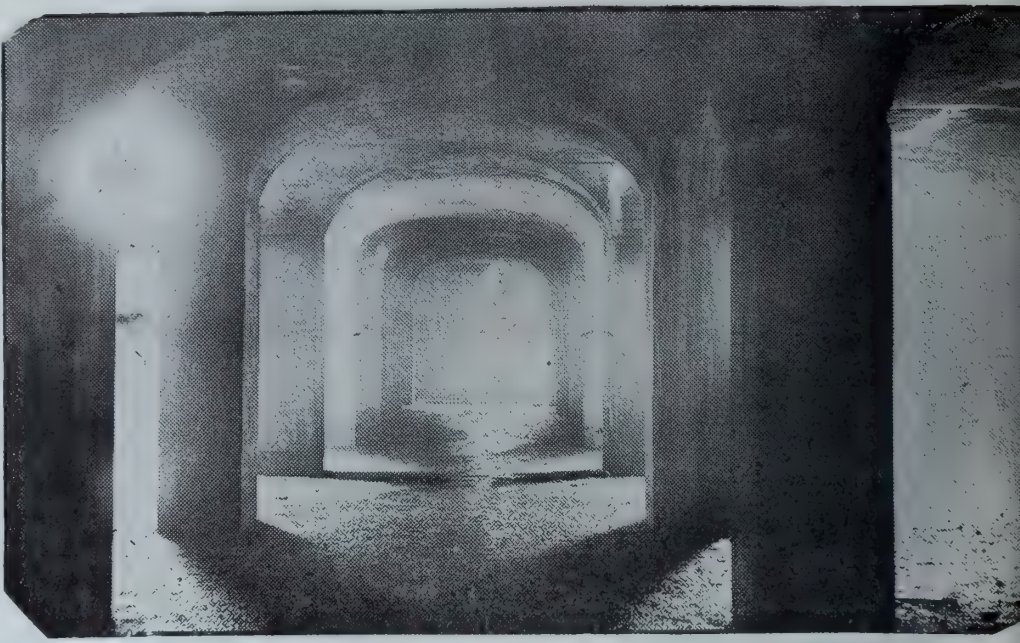
In the engine room there is the necessary electrical equipment, switchboard of twelve panels, air compressor and storage battery. Edward Freis is the engineer in charge and E. J. Phillips is superintendent.

BERLIN SEWAGE DISPOSAL PLANT.

Berlin has a sewage disposal plant consisting of two septic tanks, two storage tanks, a pumping station and 15 acres of intermittent sand filters. Twenty miles of sewers serve a population of over 12,000. The average flow is about 500,000 gallons, of which about 200,000 is waste from factories.

A disposal plant consisting of a covered 17x68 ft. septic tank with a capacity of 60,000 gal. and 12 acres of intermittent land filtration area had been in service for some years. The filtration area was largely clay, and the beds were overworked, water-logged and badly sludged over, until practically all aerobic bacterial action in them had been stopped. The brewery sent down grain husks which interfered seriously with the operation of the tanks and beds. The felt and woollen factories turned waste containing flats into the sewers. The waste from the gas works contained tar. The tannery waste contained lime, tan bark, etc. These wastes were disposed of and greatly facilitated the sewage disposal.

The two new septic tanks are each 36x136 ft. in plan, and are built with one side wall common to both. A 36x150 ft. storage tank is built at the effluent end of each tank, the adjacent ends of tanks having the same wall. The four tanks have floors and walls of concrete and are covered with groined-arch concrete roofs, carried by the walls and by piers built up from the floor. The roofs have 2 ft. of earth filling over them. A 12x36 ft. grit chamber is built at the inlet end of each septic tank and is separated from the latter by a concrete wall extending 12 in. above the normal level of the tanks.



Interior of Berlin Septic Tanks.

The outfall sewer terminates in a brick wall from which the sewage flows to the old septic tank and to a circular screen chamber built at the inlet end of the new tanks. The screen chamber is connected to the centre of the side of each of the grit chambers by a bell-mouthed pipe, submerged below the level of the sewage in the tank. The sewage flows from each grit chamber to the tank with which the latter is connected through three semi-elliptical openings in the wall between the chamber and the tank, the openings being just below the surface of the sewage in the tank. The floors of the tanks slope from the inlet end to the outlet end, the normal depth of sewage at the former being 6.5, and at the latter 7.5 ft. The outlet from each septic tank is two 18-in. half-bent pipes, with their horizontal legs through the wall separating the septic tank from the storage tank, and the end of the vertical legs submerged 4 ft. below the surface of the sewage in the former. Each of these outlet pipes is placed 6 ft. from the side wall. Midway between them on the centre line of the tank is a sump connected through the end wall to a sump in the storage tank, by a pipe controlled by a valve operated from the surface of the fill over the tanks. Each grit chamber is also connected at the bottom to the sump in the storage tanks by 14-in. cast-iron pipe laid in the division wall between the septic tanks.

An 18-in. vitrified-clay pipe also connects the old septic tank with one of the storage tanks. A connection between the brick chamber at the end of the outfall and this 18-in. pipe enables the three septic tanks to be by-passed. And one of these tanks may also be thrown out of service.

Power Equipment.

The flow from the septic tanks is allowed to pass into the storage tanks at the rate the sewage comes from the outfall. The storage tanks are emptied once in 24 hours. Two horizontal, Canada Foundry Co., turbine pumps, with a capacity of 1,000 gal. a minute, elevate the tank effluent through a force main to distributing chambers built in connection with the filter beds. These pumps are each direct-connected to a 90-h.p. Canada General Electric Co. three-phase, 60-cycle, revolving-field induction motor and are designed to run at 800 r.p.m. A 500-gal. per minute Canada Foundry Co. centrifugal sludge pump is belted to one of the motors, and has its suction in the sumps in the storage tanks. Electric power is furnished by a 100-kw. three phase, 60-cycle, 2,300-volt Canada General Electric Co. alternating current generator in the municipal power station, 1.75 miles distant. The turbine pumps operate against a total head of from 55 to 75 ft. and each pump can empty one of the storage tanks in 4 hours. A 14-in. riser main leads to the filter beds. The sludge pump discharges on sludge beds 55 ft. above the tanks.

View Showing Construction of Septic and Storage Tanks.

There are 16 filter beds with a combined area of about 15 acres. These beds are at various levels, and are supplied by gravity from the distributing chambers, one 55 and the other 75 ft. above the bottom of the sump in the storage tanks. The area on which they are built had a surface layer of loam, 6 to 20 in. thick, under which was a stratum of coarse, sharp sand of at least 20 ft. deep. The beds were formed by scraping the loam into embankments around their sides and then leveling off the sand. The excavation and embankment were practically balanced, the former being 75,793 cu. yd. and the latter 74,880 cu. yd.

The two central concrete distributing chambers are built for the 16 beds, one for those at each general level. Valves are provided on the riser main so the discharge may be diverted into either chamber. From each of these chambers 18-in. sewer pipes are laid in the embankments to a valve chamber at each end of the beds in the level served by it. The beds are laid out as nearly rectangular as possible, with straight embankments. A distributing channel extends across each bed from its valve chamber, the channels being laid diagonally. A concrete culvert with wing walls built in the embankment, connects the distributing channel when its valve chamber. Each of these channels has a concrete bottom laid with its surface flush with the surface of the bed. The sides consist of 2x10-in plank set on edge. The plank are held in place by iron rods imbedded in the concrete bottom. The channel is 4 ft. wide at the inlet end and gradually reduces in width to 1 ft. at the distant end. The flow is diverted on the beds through openings made in the sides of the channel. A reduction in width is made at each of the openings, and the plank in the sides overlap at the latter. The outer planks are beveled on the inner side. A space 6 in. wide is left at the overlapping ends of the plank on each side. The inner planks are also both hinged 1 ft. from the end, so the width of the openings on each side may be increased, the entrance of the channel beyond the opening being obstructed at the same time. The hinged ends are held in the desired position by an iron strap on the top of each of them, the straps having holes in them in which keys that fit in holes in the top of the outer planks are placed. A 3x4 ft. concrete apron is placed on the surface of the bed on each side of the openings and at the end of the channel to prevent scouring.

The underdrainage consists of a single line of 6 or 8-in. sewer pipe under each bed. These pipes are laid with open joints, 6 to 10 ft. below the surface. These lateral drains connect with main drains which join in a 12-in. sewer pipe leading to the creek. It is not believed, however, that anything like the quantity of water pumped on the beds will reach these underdrains.

The septic and storage tanks cost $18,000; the filter beds and their accessories, $20,000; the pump house $1,050, and the machinery, including the electric generator, the two motors and three pumps, $6,700.

CONVENTION PROGRAMME.

Tuesday, 11.30 A.M.—Opening of Convention.
Address of welcome, etc., Mayor Chas. Hahn.
Reply by President C.A.S.E. Executive
Report of Credential Committee.
Luncheon.
2. P.M.—President's Address.
Secretary's Report.
Treasurer's Report.
General Business.
Appointment of Committees, etc.
8.30 P.M.—Banquet at Walker House.
Present Certificates for Validation.
Theatre Entertainment.
Wednesday, 9 A.M.—General Business and Report of Committee.
Luncheon.
1 P.M.—Supply Men's Entertainment.
Games and Sports at Victoria Park.
5.30 P.M.—Luncheon Given by Exhitors at Victoria Park Pavilion.
Presentation of prizes by D. O. McKinnon.
6.30 P.M.—Return to Berlin.
7 P.M.—Victoria Hall, Open Meeting C.A.S.E. and Exhibitors.
Smoker and Papers Followed by Discussions.
W. A. Crockett, Ex.-Sec. C.A.S.E. in the Chair.
1st Paper, "Steam as a Motive Power," by A. M. Wickens.
Chief Engineer, Canadian Casualty and Insurance Co., Toronto, Ont.
2nd Paper, "Considerations Affecting the Choice of a Boiler," by A. W. Spotten, of Goldie & McCulloch, Galt, Ont.
3rd Paper, "Treatise on Economical Treatment of Condensation," by H. L. Peiler of Peiler & MacKenzie, Montreal, Que.
Thursday, 9 A.M.—General Business.
10 A.M.—Business Session C.A.S.E. Exhibitors' Association.
Election of Officers—Luncheon.
2 P.M.—Auditor's Report.
Unfinished Business.
Installation of Officers.
Adjournment.

LONDON LODGE PICNIC.

London, No. 30 C. A. S. E. held their annual picnic at Springbank Park, June 25. It was a most enjoyable event. A long programme of sports for the men, the ladies and the children were carried out in the afternoon. The following business men and individuals donated valuable and useful prizes for competition: Hunt Bros., E. Leanord & Sons, D. H. Gilles & Co., Lamb Fence Co., Denis Iron Works, Westman's Hardware, Canadian Fairbanks, D. S. Perrin & Co., Queen City Oil Co., Canadian Oil Co., Gorman Eckert Co., C. R. Somerville Co., Canada Boiler Insurance Co., Canadian Casualty & Boiler Insurance Co, Bros. S. Cosford, D. T. Campbell, Geo. D. Fowler, R. A. Lyons, R. Quale, R. Limmie, W. J. Paynter and J. Reid.

The baseball game between teams picked from the association, ended the day in a whirlwind of fun and amusement. Each engineer was dressed in a new suit of overalls. The ladies supplied the refreshments and one hundred and fifty sat down to supper in the big pavillion at Springbank Park.

SOUTH AMERICA INSTALLATION.

Up to a short time ago, Norway held the world-record of possessing the most powerful Turbines at Rjukananlagget. These turbines are of 14,450 B.h.p. each, the power being attained by two runner wheels, each developing 7,225 B.h.p.

These figures have now been largely exceeded in as much as the famous Swiss turbine builders Messrs. Escher Wyss & Co., have turned out from their works at Zurich three Pelton turbines destined for Necaxa (South America), the output of which will be of 16,000 B.h.p. each under normal head and about 18,000 B.h.p. under overload. This power is obtained by a sole runner wheel fitted with Escher Wyss patent buckets and mounted on a vertical shaft. The diameter of action of the runner is 8 ft. 8 inches. The wheel is driven by four jets of water under a head varying from 1,280 to 1,345 feet. The speed attains 300 revs. per min. Each turbine is fed by an individual pipe-line of 2,500 feet length and 3 ft. 8 in. to 4 ft. diameter.

The largest Francis turbine built hitherto runs at the Feather River Power Plant of the Gt. Western Power Co., California and develops 18,000 B.h.p. The head is 525 feet, the speed 400 revs. per min. Even in this instance the power is attained with one runner only.

OFFICERS FOR 1910.

Toronto Lodge No. 152, International Brotherhood of Stationary Engineers, elected the following officers for 1910-11: President, Garfield Jones; Vice-President, Charles Powers; Treasurer, Thomas Walsh; Cor.-Sec., R. Shepperd; Rec.-Sec., M. Foy; Fin.-Sec., J. J. Harris; Conductor, T. Boyd; Guard, T. Harding; Trustee, Ed. Boynton; Auditors, I. Mathews, W. Deering, S. Brown; delegates to central body, Messrs. Barron, Walsh, G. Leech, Lawrenson, Foy; delegates to biennial convention in Denver, Col., next September, Messrs. F. W. Barron, J. Bannon; alternates, Messrs. T. Walsh, G. D. Bly.

The Twentieth Annual Convention of the Canadian Electrical Association, Royal Muskoka, 1910.

Twentieth Annual Convention C.E.A., at Royal Muskoka

The 1910 Convention of the Canadian Electrical Association was a Big Success Both in Point of Numbers Present and Enthusiasm.

The twentieth annual convention of the Canadian Electrical Association was held at the Royal Muskoka, Lake Rosseau, July 6, 7 and 8. In point of numbers there were about 200 present. The majority of these arrived on Tuesday and during the whole convention there was a keen interest shown in the papers and entertainments.

The papers were of special interest to central station men and engineers. The discussion brought out the strong points of each paper and the general exchange of opinion presented various phases of the different subjects, which were of interest and use to all who listened to the discussions.

A special committee provided for the entertainment of the ladies. Gasoline launches, canoes and skiffs were at the disposal of the association and advantage of this was taken by members and guests to take trips around the islands and to points of interest on the lake.

The convention committee consisted of W. L. Adams, (chairman), R. G. Black, R. F. Pack, W. A. Bucke, T. J. Lynch, V. Boyd, T. F. Dryden, W. M. Andrew, T. R. Fulton, P. S. Coate, G. C. Rough, A. L. Mudge, C. H. Mitchell, D. H. McDougall, L. V. Webber and T. S. Young.

The papers committee included A. L. Mudge and R. G. Black. In the banquet committee were T. J. Lynch (chairman), R. G. Black, W. N. Ryerson and T. F. Dryden. The sports committee consisted of P. F. Pack (chairman), P. S. Coate, G. C. Rough, W. A. Bucke, T. R. Fulton and V. Boyd, and the transportation committee of V. Boyd, T. S. Young and R. F. Pack.

Wednesday, July 6.

The first session opened with P. S. Coate, manager of Chatham Gas Co., 1st vice-president, in the chair. A letter was read from W. N. Ryerson, general manager of Great Northern Power Co., Duluth, Minn., regretting his inability to attend the convention and expressing his best wishes for success of the 1910 annual gathering.

The minutes of the 1909 convention at Chateau Frontenac, Quebec were read by the secretary, T. S. Young, and approved. The secretary-treasurer's report was then presented showing an addition of 92 members and the removal of 55, a net gain of 47. On May 31, there was a total membership of 468 and a balance on hand of $969.20.

The question of affiliating with the National Electric Light Association came up for discussion and on a motion of R. G. Black, a committee was appointed to consider the question and report at a later meeting.

P. S. Coate then read a paper "Some Practical Considerations Concerning Contracts for Lighting and Power Service," by President W. N. Ryerson. The president decided to depart from the custom of giving a review of electrical developments and present this paper. Among the subjects treated were terms of contract, price or consideration, uses to which current is to be put, point of delivery, meters, access to customers' property, balancing of phases, power factor penalty for non-payment of bills, penalty for interruption to service, excess power, arbitration, supervision of consumers' apparatus, definition of delivery, voltage of supply, frequency, mutual liability, definition of terms, assumption of liability to successors and assigns, sole use of generating company's power, delay in delivery or use, deposit or other guarantee and lamp renewals.

Under these topics were given suggestions for use in making contracts for power. The paper was followed by one on "The Commercial Agent and the Community," by C. Alfred Littlefield, of the New York Edison Co., of New York. These two papers were of a similar nature. The reading was followed by an interesting discussion.

Mr. Littlefield described the methods followed by the Edison Co., in New York to secure business. He described the various bureaus such as the new building, power, sign, heating, engineering bureaus, etc., into which their business is divided. He pointed out that in dealing with laymen, contract forms should be as simple as possible.

After an adjournment for lunch S. E. Doane read a paper contributed by S. Bingham Hood of the Toronto Electric Light Co., on "The R. M. C. Electric Service Rate System." This is a differential rate system composed of a readiness to serve charge, a consumer's charge and kilowatt hour or meter charge. The paper suggested that power be charged at certain price per square foot. This is a departure from the present general method of charging and brought forth much discussion.

Residential Lighting Field.

A. T. Holbrooke, New York, followed with a paper on "The Residential Lighting Field; How it can be Profitably Cultivated." Mr. Holbrook pointed out that only 10 per cent. of the residences in central stations and towns in North America are connected to the service of the electric-lighting company.

The rate advocated by the writer is based on a fixed charge of not less than $120 per kilowatt per year of actual station demand. On a monthly basis it is equivalent to 1 cent per watt per month. This return of $120 per kilowatt per year is a larger return than most companies receive from other so-called better classes of business. Tungsten lamps of standard voltage are used and the current is sold subject to use without variation of cost during ordinary lighting hours. The demand is rendered definite by the use of an excess indicator which is installed for that purpose.

The function of this indicator is to serve notice on the customer when he has exceeded his demand and to safeguard the lighting company against any unfair treatment on the part of the customer.

The operation of the instrument never varies and there is consequently no possible chance for argument. By use of this instrument a house with six rooms may have nine 25-watt lamps and contract for four and use up to this number for $1 a month while a larger house will be compelled to use probably 8 or 9 out of a total of 20 or 25 at a cost of $2 or $2.25 per month.

The discussion on this paper brought the afternoon session to a close. The guests spent the remainder viewing and taking part in aquatic sports such as canoe races, tilting tournament, etc. In the evening there was an informal reception and dance.

Thursday, July 7.

A. A. Dion, chairman of the committee to consider the matter of affiliation with the National Electric Light Association presented verbally at the Thursday morning session the conditions which would exist if the members decide on affiliation. The matter was again referred to the committee. Frederick Nicholls, in the discussion of the question advocated that the Canadian Electrical Association remain an entirely separate association.

R. F. Pack, chairman of the committee on "A Uniform System of Accounting," presented the report. This report contained the classification of accounts adopted by the National Electric Light Association. This report contained details of a system which could be adopted by any central power station selling power. The report was adopted and copies will be mailed to every central station in Canada. Other members of the committee were: F. A. Chisholm, R. J. Clark, D. R. Street and F. B. Warner.

Protection of Service.

A very important paper on power house practice, "Protection of Service in Large Electric Systems," was presented to the Association by A. S. Loizeaux, of the Consumers' Gas, Electric and Power Co., Baltimore, Md. In the absence of Mr. Loizeaux, it was read by A. A. Dion. While the paper has been written with the large power plant in view, there is also a great deal of interest to smaller power stations, though, of course, discretion should be used in applying the paper to the small plants.

This paper is reproduced in this (July) issue of The Power House, in connection with the report of the C.E.A. Convention and should be read with a great deal of interest by all engineers in charge of power plants.

"Notes on Transmission Line Regulation," is the subject of a paper prepared by Paul M. Lincoln, of Westinghouse Electric and Mfg. Co., Pittsburg, and read by C. F. Scott. Tables were given to calculate quickly the drop between generating and receiving station.

The verbal report of A. A. Dion on Grounding of Transformer Secondaries concluded the morning session. No resolution was presented on this subject.

New Officers.

The Executive held its business session Thursday afternoon, when the following officers were elected:

President, P. S. Coate, Chatham.

1st Vice-Pres., E. A. Evans.

2nd Vice-Pres., W. L. Adams.

Secretary-Treas., T. S. Young, Toronto.

Managing Committee: W. N. Ryerson, A. A. Dion R. G. Black, F. A. Chisholm, A. L. Mudge, J. J. Wright, R. F. Pack, W. L. Bird, L. V. Webber and D. H. McDougall.

Thursday evening a banquet was held in the dining hall of the Royal Muskoka. The president, P. S. Coate was toastmaster.

Friday.

A paper by Sidney G. Redway, discussed, "How to Increase the Station Load," and showed how new customers might be secured. It was followed by a paper on "Electric Heating and Cooking Appliances."

The committee on meter installations reported on the "Instalation, Care and Testing of Meters.

On Friday afternoon two papers were read, one by R. E. Scott on "The Attitude of the Central Station Manager Towards Illuminating Engineering," and the other by C. L. Stephens on "Tungsten Street Lighting with Special Reference to 25 Cycle Circuits."

The place of the next convention has not been decided, but Ottawa is spoken of as the place for the 1911 meeting.

Convention "Sparks."

The many friends of H. G. Nicholls were pleased to shake hands with him again, after his serious illness.

The Northern Electric & Mfg. Co., Montreal and Toronto, presented each guest with a very useful souvenir in the shape of a B. & S. standard self-registering direct reading wire gauge.

One of the new members of the C.E.A. was Leonard Andrews, managing-director of the Key Engineering Co., London, Eng. He is making a trip through Canada studying conditions for a trade in large gas engines.

The Canadian Westinghouse had an excellent Nernst lamp and fixture exhibit in the Japanese room.

The Canadian Tungsten Lamp Co., Hamilton, presented each member with a germ proof telephone "mouth piece."

LONDON C. A. S. E. OFFICERS.

London Branch, No. 30, C. A. S. E., held their annual election of officers on June 28, at 211 Dundas Street, the results being as follows, Past President, D. F. Campbell; President, G. D. Fowler; Vice-president, S. Cosford; Doorkeeper, J. Potts; Recording Secretary, J. R. Stephenson; Financial Secretary, D. J. Freedy; Treasurer, J. Greason; Conductor, J. E. Middleton; Trustees, R. Lyons, G. Galloway and A. T. Breathwaite; Delegates to Berlin Convention, D. F. Campbell and G. Galloway. C. McGhie, of Toronto, chairman of the stationary engineer's board, addressed the engineers in their club rooms, 211 Dundas Street, the following evening, when there was a large turnout of London engineers to hear his address.

Protection of Service in Large Electric Systems

Paper Read at C.E.A. Convention, July, 1910, describing the System of Caring for the Prime Movers and Equipment of a Power System.

By A. S. Loizeau.

Continuity of service is an essential characteristic of the supply of electricity from a large central station. The public in our large cities relies absolutely on electricity for lighting, for transportation, for industrial power, for telegraphic and telephonic communication, and for the operation of numerous devices now indispensable to business, and to modern life in all its phases.

This absolute reliance upon electricity for the many activities of a large city makes it necessary to protect that service in every possible way. From the coal pile to the consumer every part of the system must be safeguarded and protected to avoid any one of the many conditions that would cause interruption to service. Emergencies must be provided for, even if such emergencies are remote, and the cost of protection is high.

A complete shut-down of all electrical power in a great city would paralyze business, and create a panic. Fortunately, thanks to the possibility of storing direct current in batteries, the complete cessation of all electric operations in a great city is unheard of, and is practically an impossibility.

Buildings.

All central station power-houses and sub-stations are to-day made of the most substantial and thoroughly fireproof construction. Wood is almost entirely eliminated, being replaced by metal or compositions of non-inflammable material, such as asbestos lumber. Heavy fire walls are used to sub-divide buildings, and double fire doors close all passageways through such partitions. When it is necessary to keep fire doors open they are made self-closing and held open by fusible links.

The switchboard operating rooms of generating stations are separated from the engine rooms by partitions with wired glass windows. This enables the operators to see the generating units and at the same time protects them from the steam and noise that accompanies a break in a steam pipe, or other accidents. A sense of security to the operators is most valuable in time of emergency, because it gives them presence of mind and enables them to keep their post to cut out defective machines and restore service.

Fire Protection.

In addition to the safeguards mentioned, it is desirable to isolate buildings for electrical service, and this is done where land is not so expensive that the cost is prohibitive. When located within the city, generating stations usually occupy separate blocks, so that the danger of fire from nearby buildings is minimized. The Baltimore Lighting Company located its main station on a large property on the water front, outside of the city, to be free from all danger of fire from outside sources. The same is true of the Fiske Street station, Chicago.

The problem of extinguishing a fire promptly has been met by the use of water, or by chemical extinguishers. The use of water in an electric station is objectionable, unless the entire building is in danger, and the service must be discontinued. Chemical extinguishers are of value in small fires as they are not so destructive to property, and they are more effective when they can be used. In the last few years the great value of carbon tetra-chloride has been discovered in connection with extinguishing electric arcs, oil fires or incipient fires of any description. This liquid is extensively sold under the name of Pyrene, and small squirt-guns are provided to project the fluid into the fire. The remarkable properties of carbon tetra-chloride are, first : its great power of extinguishing flames, its action being due to the formation of gas, which deprives the fire of oxygen ; second, its high insulating power, and third, its non-corrosive and generally harmless character. One-twentieth of an inch of carbon tetra-chloride will stand twenty thousand volts before break-down. The fluid volatilizes rapidly on exposure to the air, and can be used with impunity on electrical machines of any description. The use of carbon tetra-chloride should be considered a valuable step in the protection of electrical properties from fire.

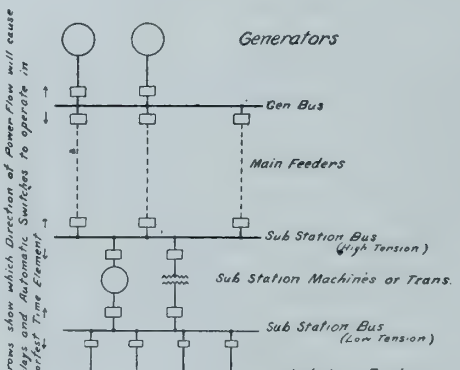

Arrows show which Direction of Power Flow will cause Relays and Automatic Switches to operate in shortest Time Element
Generators
Gen Bus
Main Feeders
Sub Station Bus (High Tension)
Sub Station Machines or Trans.
Sub Station Bus (Low Tension)
Distribution Feeders

Fig. 1.—

Fuel Supply.

It is the practice of most large companies to keep a reserve storage of coal to continue operation in the event of strikes, which would cut off the usual supply. This storage is expensive, because of the capital invested, the ground occupied, and the depreciation of fuel value in the coal, due to exposure ; nevertheless, the outlay is jusfied by the insurance given against shut down. The New York Edison Company keeps 200,000 tons of coal in reserve at Shadyside, New Jersey. A number of years ago, before this reserve was provided, a coal strike occurred, and it was necessary to import coal from England, to prevent a shut-down of the service.

The water supply of a power-house is as essential, if not as costly, as the fuel supply. In order to ensure continuous service, it is necessary to have at least two sources of water supply, and to have the water piping so arranged that any break in the piping may be promptly cut out by valves, and the supply obtained through another channel. A few weeks ago the United Railways Company, of Baltimore, was surprised by a break in the city water mains from which it obtained its supply, and it was forced to procure electric power for over an hour from the lighting company, until another water supply could be connected.

Boilers and Steam Piping.

Steam boilers are often arranged in groups, each group being connected to a prime mover, this arrangement making an accident to boilers or steam piping affect only one generating unit. This system is used in the Fiske Street generating station in Chicago, where each 10,000 k.w. steam turbine is connected to a group of four boilers.

Another means of providing against boiler failure is the use of automatic steam valves. These valves are provided on each boiler, and are arranged to close when an abnormal drop of pressure occurs on either side of the automatic valve, due to a break in the steam line or boiler. In the Westport power house in Baltimore, the boilers are protected by schutte valves ; on two recent occasions a boiler tube burst, and these valves automatically closed, limiting the escape of steam to a single boiler, and preventing a shutdown of the entire station. The action of the valves in this case was so prompt that the operators in the engine room were not aware of the accident.

Prime Movers.

Prime movers in general are not as subject to sudden break down as are other parts of the electrical system. Protection against breakdown in prime movers has been provided by the manufacturers in their continual efforts to strengthen and improve the design. It is possible for prime movers to race and wreck themselves due to the governor failing to act. To prevent this on steam turbines, and on some engines, a centrifugal device is used which trips a special valve and cuts off the steam supply, when a certain speed has been exceeded.

Generators.

Generators are subject to breakdown of insulation or to breakage of parts. To avoid interruption in case of a break-down of generator insulation, automatic switches are used, operated by reverse load relays. Overload relays are not used on generator circuits because, in the event of a short circuit on the system, all of the generators might trip out ; and in the event of an overload, if one generator tripped out, its load would be thrown on the other generators that were running, which would, in turn, be overloaded and trip out, shutting down the entire system.

Ground Detector Waterside Station N.Y Edison

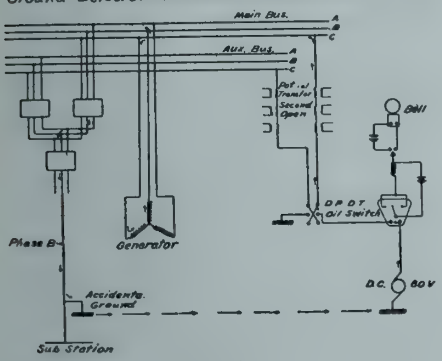


Fig. 2.—

Breakage of parts in generators is usually caused by abnormal strains developed by short circuits. Fly-wheel generators are inherently safeguarded to some extent from this danger because of their relatively high impedance. Turbo-generators, however, have few poles and very low impedance, consequently, under short circuit conditions, a turbo-generator develops an enormous torque, especially when this short circuit is not separated from the machine by any great length of line. Abnormal strains in a turbo-generator, under short circuit conditions, can, however, be prevented by the use of reactance coils in the generator leads. The effect of these coils during normal operation is to slightly lower the power factor of the circuit and to absorb a small amount (a fraction of one per cent.) of the energy of the machine. Under short circuit conditions, however, the power factor is lowered to a very small value and the current is considerably reduced, the effect of this being to make the torque on the turbine shaft a small faction of what it would otherwise be. The Baltimore company was one of the first in this country to provide such protective coils. In this case the torque on the generator under short circuit conditions is only 1.8 times full load torque, whereas, without the coils, it would be possibly twenty times the full load torque. The value of these reactance coils was demonstrated quite recently when a short circuit occurred in the Baltimore power house on a cable close to the bus bars. The automatic switch opened the short circuit without difficulty and the generator and reactance coils were entirely unharmed.

Exciter System.

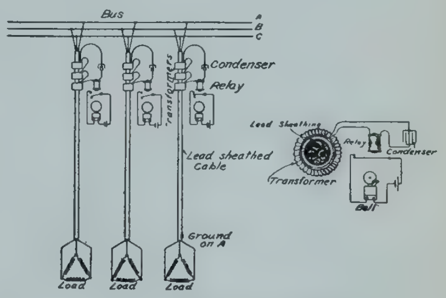
The protection of the exciter system is important because any interruption to the field supply means a shut down of the entire generating station. Storage batteries are always used in connection with this service, and the battery is kept floating on the field bus bars so that any accident to exciter generators will not interrupt the field service. The exciter generators are provided with reverse current relays to automatically open the connection in case of trouble in the machine.

Main Feeder System.

In large cities the distribution of power from generating stations is almost exclusively done by underground three-phase cables. The cable system is the most vulnerable point of an electric system, and although cables are tested to double-working voltage, they occasionally break down in service. This break-down is due generally to mechanical injury of the lead sheath, which permits the ingress of moisture, and causes the ultimate break down of the insulation. In order to protect the service from interruption when such a cable failure occurs, elaborate protective apparatus has been devised. This apparatus consists of various types of relays, which are connected to the secondaries of current transformers located on the main circuits and operate under conditions of overload or reverse load, and close their contacts either instantaneously or after a definite time interval, or after a variable interval of time which is determined by the severity of the conditions in the circuit, the more severe the conditions the more rapid being the operation of the relay. Relays of the last mentioned type are ordinarily called "Inverse Time Element Relays"; the time, however, is not inversely proportional to the strength of the current in the circuit, but each type of relay has an operating characteristic of its own.

The complete operation of a relay closes a separate circuit which trips an oil switch in the main circuit. These oil switches will rupture a surprisingly large amount of energy, but they are taxed to their fullest capacity by the immense amounts of power now being concentrated in single systems, it being a noteworthy fact that when a short circuit occurs on a system, the switch opening that short circuit is called upon to rupture not only the maximum load capacity of the circuit to which it is connected, but the entire capacity of the generating system to which it is connected, limited only by the impedance of the lines and fault peculiar to the particular short circuit.

In protecting the conductors of an electric system the principles involved are simple, although the details of the various devices and connections are complicated in the extreme. The first consideration for protection is the provision of bus bars installed in thoroughly safe compartments. These compartments are made of masonry and prevent any accidental contact to the bus bars. The bus bars themselves are mounted on insulators, with a very large factor of safety, so that it is practically impossible for a failure to occur on the bus bars themselves. Two sets of bus bars are provided to enable either set to be cleaned while the other set is in operation, or to isolate a particular service or in cases of emergency to isolate a part of the service.



Ground Detector New York Edison

Fig. 3.—

The principle observed in the use of relays on the feeders connected to bus bars is illustrated in Fig. 1. The bus bar is the channel or centre which must be kept in operation at all times, and the abnormal rush of power away from the bus bar, in either direction, should operate the relays and open the circuit affected, thus preserving the bus voltage and preventing a shut-down. This principle determines the use of overload or reverse load relays : thus, in a generating station, on the generator circuits, reverse load relays are installed, while on the outgoing feeders, overhead relays are installed; similarly in sub-stations on the incoming feeders or generator circuits, reverse load relays are installed, and on the outgoing distribution lines or machine circuits, overload relays are employed.

In order to disconnect a defective feeder between generating and sub-stations, without interrupting the supply to the sub-station, it is obvious that at least two feeders must be in operation. If two feeders are in operation and a short circuit occurs on one, the two switches in the power house experience an overload. The switch in the sub-station on the good cable carries an overload, and the switch in the sub-station on the defective cable carries reverse load. It will, therefore, be seen that if the relays operated instantaneously all of the four switches would open. It, therefore, is necessary to so adjust the time of operation of these relays that only the defective cable will be disconnected, and the good cable left in operation. This is accomplished by the inverse time element action of the relays, and although the problem can be successfully solved for a particular current, the conditions vary so widely in practice that it is a difficult matter to prevent other switches than the ones on the defective cable from operating. Frequently the shock to a system, occasioned by a short circuit, is so widely extended that many switches remotely located from the breakdown will open. When three or more feeders are connected between generating and sub-stations, the selective action of the relays is increased, and it is easier to disconnect the defective feeder without interrupting service than when only two feeders are operating. This is readily understood by considering the relative amount of current that would flow through the switches under the two conditions. When only two cables are connected and a fault occurs in one, the sub-station switch on the good cable carries the same amount of current as the switch on the defective cable, unless there is synchronous apparatus in the sub-station, which can, by virtue of its inertia, deliver power to the fault. The selective action of the sub-station relays, therefore, depends simply on the fact that the relays are designed to operate more quickly under reverse load than under overload. When, however, three cables are connected, each of the switches on the two good cables carries only one-half as much load as the switch on the defective cable, giving a greater difference in the time element of operation, and enabling the defective cable to be disconnected with much less likelihood of tripping other switches than those intended to operate. The same reasoning applies to switches in the generating station. An element entering into the condition which, for the sake of simplicity, has not been mentioned before, is the regular load of the sub-station, which tends to make the operation of the proper relays less certain than if no load were being carried. The Boston Company is now making tests on the operation of relays and automatic switches, by producing a short circuit at the end of a long system of feeders, and seeing whether it is possible to so adjust the automatic devices that the defective portion may be cut out, without opening other switches.

Relays.

It is important that all relays on the same system expected to select by time action a defective feeder or machine must be of the same type in order to have the same characteristics and operate in the expected order under varying conditions, and even if the relays are of the same type, it is questionable whether, under the shock of a short circuit, the time element of the switch itself is not so long that other relays supposed to operate at a later moment, will have closed their contacts before the main circuit has actually been ruptured. If the time that intervenes between the closing of the relay contacts on the defective cable, and the actual isolation of the fault is greater than the difference in the time elements, under the conditions, of the relays on the defective and the good cables, then the switches on the good cable will also operate and service to the station will be interrupted.

An interesting application of relays sometimes used to disconnect a defective bank of transformers from the system, consists in providing sets of current transformers on both the high and low tension circuits of the transformers. Secondaries of these transformers are brought to a differential relay, the coils being so connected that when power is flowing in a normal direction in both circuits, the coils oppose each other, and no action of the relay is produced. When, however, a short circuit occurs in the transformers the direction of power flow changes in one of the circuits, the relay coils assist each other and trip the oil switches on both high and low tension sides of the transformer bank.

Connection of Main Feeder System.

The connection of generators or transformers in the primary distribution of power from a large generating station presents a problem of protection which may be solved in several different ways. One method of solution is to connect the high tension windings of the generators or transformers in star, and to ground the neutral point through a resistance. This resistance is designed to limit the current flow in case of a ground on one of the transmission conductors to a value not injurious to the apparatus, but sufficient to immediately trip the automatic switches.

When a high tension feeder cable breaks down the initial failure is, in almost every case, from one conductor to ground, and the advantage of the grounded neutral system is that when such a ground occurs the cable is automatically disconnected in the manner described without subjecting the system to the great strain of a dead short circuit.

Another connection of the main feeder system in general use is the ungrounded system usually delta connected. In this system, if a simple ground occurs, the automatic switches do not trip, but if the cable is not promptly disconnected a short circuit will occur. In an ungrounded system the break down of one conductor to ground forms a path for an arc which carries the charging current of the system. This current varies according to the extent of the system, from a few amperes to sixty amperes or more. It will be realized that in a large system, with an arc of this capacity, it will take only a few minutes to burn away sufficient insulation to convert the arcing ground into a short circuit between phases.

A very interesting and ingenious method of detection of grounds is employed by the New York Edison Company. The apparatus and connections used are shown in Fig. 2. The device consists of coils of wire surrounding each of the three conductor feeder cables. These coils form the secondary of a current transformer of which the triplex cable is the primary. This primary is ordinarily balanced and produces no current in the secondary. When a ground occurs on a feeder the charging current flowing into the ground, which is about sixty amperes on this system, unbalances the three-phase current and produces a current in the coils mentioned which operate a relay on a signal board, indicating the number of the feeder affected. The relay operates an alarm gong which calls the operator to immediate attention, and enables him to connect a spare feeder to carry the load, and then disconnect the affected feeder before harm is done.

An effort was made by the same company to detect incipient grounds by a delicate indicator, and in this way to detect and repair a defective cable without the occurrence of a decided ground. This apparatus is shown in Fig. 3, and consists of a direct current voltage impressed between the high tension, alternating current bus bar and the ground, with a high reactance inserted to prevent grounding of the high tension bus. An incipient ground would then form a path for the direct current while the reactance would prevent the passage of alternating current. The direct current would influence a sensitive galvanometer and warn the operators of impending trouble. The weak point of this device is its inability to select the feeder on which the trouble exists, and if the unbalanced current is not sufficient to be detected by the current transformer and relay above described, the only way to locate the defective feeder is to disconnect each of the feeders in the station one after the other until the indication of ground ceases, when it is known that the defective feeder has been reached.

Interchange of Power Between Systems.

In recent years the great national movement toward consolidation of large enterprises has extended to the electrical field, and it is common for large electric generating systems to have connections with adjoining systems for the mutual interchange of power in cases of emergency; in fact, the protection given to the continuity of service by such facilities for interchange of power has frequently determined the voltage and frequency of transmission. An example of this is seen in the New York power systems, where the great stations of the New York Edison Company, the Manhattan Elevated Railway Company, and the Interboro Rapid Transit Company all generate at sixty-six hundred volts and twenty-five cycles, and have facilities for the interchange of power during emergencies. In Baltimore, the railway and lighting companies have the same system of transmission, and one company has frequently supplied power to the other during emergencies.

Water Power and Steam Power Generations.

Water power generation in connection with long transmission lines is much more subject to interruption than steam generation distributing power through underground cables. For this reason it has been difficult to sell water power at a profitable figure, unless uninterrupted service was guaranteed and a steam reserve plant maintained. Even when the water flow is abundant and constant, as in the unique case of Niagara Falls, the cities obtaining power find it necessary to maintain steam reserve in order to guarantee the service, the transmission system in these cases being responsible for most of the shut downs that occur. In Syracuse, N.Y., a steam station is maintained for reserve, and to supply power during the time of peak load. Steam turbines are kept on the line operating as synchronous condensers, improving the power factor of the system. When protection is required for peak load or emergency conditions, steam is admitted to the turbines, which at once assume a part or all of the load.

Distribution to Consumers.

The greatest single means of protecting distribution circuits from interruptions is the placing of conductors underground. Modern methods of subway construction consisting of vitrified ducts laid in concrete with well-constructed manholes at frequent intervals, and the use of high-grade paper insulated lead covered cable, affords the most safe means of distributing power that has been devised. A striking example of the vast difference between the security of overhead and underground service in time of storm was experienced in Baltimore, March 4th, 1909. A blizzard at that time carried down practically all the telegraph and telephone single wire circuits, and a large part of the electric light and power poles and conductors, so that it was several weeks before complete restoration could be made of all services. The underground service, however, was not affected in the least by the unusual conditions, but continued operating without interruption. It is not, of course, feasible from an economical standpoint to place all conductors in suburban districts underground. Combinations of underground and overhead service have, however, been devised, which offer considerable advantage from the standpoint of continuous service. One method being tried out in Baltimore, for alternating current distribution, consists of having the main feeder and its branches in underground construction, the cable terminating at transformers placed either in a manhole or on a pole in the centre of a block, and from these transformers, distribution to the various buildings in the block is made overhead. The transformers, of course, have primary fuses, and it is expected that this method of distribution will prove reliable and not too expensive for use in sections of the city where the amount of service used would not warrant house-to-house underground service.

Storage Batteries.

The possibility of storage of direct current in batteries has been a large factor in determining the use of direct current for supplying electricity to the important districts of a city. In order to store sufficient power to carry the load in case of failure of power supply, it is necessary to make a heavy investment in storage batteries to carry the peak load for as short a period as fifteen minutes, or the average load for perhaps one-half hour. This length of time is generally sufficient to enable the trouble in the generating or transmission system to be cleared so that service to customers is not interrupted. In recent years an improved battery called the "Exide Battery" has been developed, which is made up in very thin plates, and has a maximum discharge rate of about twice the rate of the peroxide of lead batteries, formerly standard for all heavy work. The exide battery will not give as many discharges as the peroxide battery in the course of its life, but its higher discharge rate and greater capacity for equal units of weight and cost make it a much better proposition for standby service, where the object is exclusively one of protection against interruptions, and not for carrying peak loads. Some conception of the large outlay required for storage battery equipment may be had from considering the fact that a single exide battery capable of delivering five thousand kilowatts for one-half hour, will cost about a quarter million dollars for battery together with its housing and equipment. This is an investment of $50 per kilowatt. The peak load on the direct current service in Baltimore is over seven thousand k.w., and in New York City the peak load on direct service is over ninety thousand k.w.

It has been frequenty pointed out that for the immense sums spent in storage batteries for the purpose of ensuring service, additional generator equipment of large capacity might be installed; this, however, is not equivalent to the storage battery protection, because certain emergencies can occur which can cripple the transmission or generating system and spare generating capacity would be of no avail to maintain the service.

Lightning Protection.

When distribution is made by underground cables, it has been found that no apparatus for lightning protection is required. Apparatus has been installed to relieve the system from electrical surges, but in general such apparatus has been found more productive of trouble than helpful, and has been removed.

In the distribution of electricity by overhead conductors it is essential that lightning arresters of some type be used to protect station apparatus and line transformers from burn-out. For can be given for charging, etc., the new electrolytic arresters seem to be superior to any other type. It is not practical, however, to use these on outside lines for the protection of transformers and small installations. In these cases some of the other types of lightning arresters must be used. There are, at the present time, several lightning arresters of comparatively low price, making use of gaps and resistances in various combinations of series and shunt connections, all of which have their merits and defects. The function of a lightning arrester is to protect the line and apparatus from abnormal voltage stresses, and while doing this to remain, itself, in an operative condition in readiness for the next lightning discharge or voltage disturbance. A lightning arrester may protect the line to which it is connected, but, itself, burn up in the event of a discharge.

or, on the other hand, it may be free from the danger of itself burning up but not afford adequate protection to the apparatus. The ultimate test to determine the value of arresters in every case must be their comparative action under the same conditions in long-continued experience with numerous actual instalations.

Duplication of Apparatus.

Practically every part of the central station system is in duplicate, so that the most unusual break-down will interfere with the service only long enough to switch out the defective apparatus, and switch in the reserve.

The total number of generators are never counted upon for their combined capacity, but one of the largest units is regarded as reserve. This principle holds true for exciters, feeder-cables and sub-station apparatus.

Spare Parts.

Spare parts of the most important apparatus are kept on hand to be immediately ready to replace parts that break down ; for instance, companies using Curtis turbines keep spare step bearings ready for immediate use in case of accident. Generator coils and coils of other important machines are kept on hand for quick replacement of coils which may burn out.

Machine Shop.

A machine shop is provided in connection with large generating stations to make the emergency repairs which inevitably are required at some time to place apparatus promptly in service after some slight accident.

Inspection.

An important requisite to ensure continuity of service is that skilled attention be given to apparatus and that periodic inspection be made to detect flaws of any kind, which would ultimately lead to break-down. Many accidents have been forestalled by the careful inspection of station apparatus and lines. Some time ago the generators in one of the Baltimore stations were overhauled, and it was found that several steam cylinders were cracked. These cylinders were, of course, promptly replaced and in this way serious trouble avoided.

Construction and Maintenances.

Nowhere can higher grade construction and better maintenance be found than in the plants of large electric companies. The outlay is made not only to produce a plant of permanent value, but to ensure continuous operation as far as design, workmanship and material can do so.

Operation.

The complications that arise in the operation of a large system call for rapid and intelligent action on the part of the operating department. The need of the continual presence of a skilled operator in touch with all conditions of the various parts of the system, has led, in the larger companies, to the creation of a position known as a "load dispatcher" or "system operator"; this man has before him a map of the entire system, and a record of the loads at various points reported from hour to hour, or at shorter intervals. Any emergency arising in the system is absolutely controlled by the load dispatcher, who is in a position, by reason of his training and of the information and communication facilities at hand, to immediately apply the proper remedies for the re-establishment of service in case of break-down.

In the New York Edison Company an automatic electric signal system has been devised : this consists of a sending mechanism with ten combinations of signals for ringing gongs in the various sub-stations. The system operator by this means can call the attention of operators in all the sub-stations in the system, at the same moment, and can instruct them what to do in emergencies. Besides this automatic system, private telephone wires extend to every sub-station as well as telephone connections through the city centrals.

From what has been said it can be realized that reliability of electric service is obtained only at high cost, and with much attention to details in every part of the system. As in the case of all other commodities, the superfine article costs much more and commands a much higher price than the less highly finished product. It is possible to generate and deliver electrical power, with no special provision to ensure continuity of service, for one-half the cost of furnishing the same amount of power, safeguarded at every step as it is in the larger municipalities, to avoid interruption to service of any kind. This fact is usually overlooked by the public and often by officials of municipalities, and new companies are started or proposed to start, promising to deliver power at great reduction in rates ; it is found, however, on close analysis of the actual conditions, that the high cost of power, which at first appears possible of reduction, is due to the public demand for service which is free from interruption of any kind.

Electric Plant of Goderich Elevator and Transit Co.

Power and Lighting Plant at Goderich, describing Boilers, Engines, Generators, Motors, etc., with the Special Features of the Instalation.

By JOHN THURLOW

The Goderich Elevator and Transit Co. has a complete power plant at Goderich with several interesting features and a great number of machines are included in the equipment. From the boiler room to the application of the power, the equipment is up-to-date. Two return tubular boilers 16x60 inches with stationary grates, weight and lever safety vales set for 110 lbs., one duplex pump $5\frac{1}{4}$ x $3\frac{1}{2}$ x 6 inches, built by the Northey Mfg. Co., one $1\frac{1}{2}$ inch hot water Penberthy Injector connected so as they can use either or both, are included in the boiler room equipment. A brick chimney 165 ft. high gives good draft.

The Engine Room.

The main engine is a simple Wheelock 22x50 inches running condensing, with a speed of 78 r.p.m. It has an 18 ft. flywheel, 3 ft. on the face, belted to a counter shaft which goes through the wall between engine and generator room, where another belt runs from countershaft to generator.

When first installed, the engine had its main shaft coupled to a long line of shaft with bearings supported on cement foundations, a distance of some 50 feet between engine room and the elevator building in general. This shaft continued on into the building on the ground floor and rope drives transmitted the power throughout the building. An Ideal high-speed engine 8x10 inches running 276 r.p.m., belted to a 110 volt, 100 ampere D. C. bipolar Edison dynamo, furnishes light for the entire plant. Seven enclosed arc lamps and 150 incandescent are used for lighting. A 14x20 inch belt driven condenser is used and 24 inches of vacuum is maintained. A feed water heater is connected to exhaust pipe and the feedwater is pumped through this before entering the boiler.

Lake Huron water is used, being soft and containing very little lime and scale forming substances, thus making it an easy matter to keep the boilers clean.

Generator and Swithchboard Room.

The generator is an Allis-Chalmers-Bullock, as are all the motors excepting two C.G.E. The generator is a 600 volt, 3 phase, 60 cycle, 200 k.w. machine, running 600 r.p.m. On the end of the mainshaft is a pulley which drives a 125 volt D. C. exciter, the terminals of which are shown in illustration, where they come out of a curved conduit and are connected to carbon brushes, which bear on a pair of collector rings on mainshaft, insulated from one another and one passed under the other. Then they are carried along main shaft to the coils, as it is a revolving field machine.

The switchboard is equipped with two throw switches, the right hand side being the starting side and the left running side. Looking at cut the top row commencing on left side is Nos. 1, 2, 3, 4, 5, second row from left to right, 6, 7, 8, 9 and 10, down somewhat lower, having a self-contained starting box on back of panel. There will also be noticed the exciting current switch, a circuit breaker switch rheostat wheels and a line tester for the ten circuits to motors.

Three Westinghouse A. C. ammeters are connected to the three phases and one 700 volt A.C. registering volt meter. Nos. 1, 2 and 6 motors are controlled when started by starting box, No. 1 from left hand side of switchboard, No. 2 handles 3, 4 and 7, while No. 3 controls motor No. 8 only, and box No. 4 controls motor No. 9 only, No. 5 motor only being 5 h.p. does not require a starting box. All wires to the different motors drop into conduits behind the switch board and pass under ground into the elevator building right to the different motors. A large cutler hammer rheostat is used for regulating the voltage, as it varies considerable with the variations of the load.

A large battery of wet cells is located in generator room, which is connected to an electric bell, the circuit wires are encased in conduits and are all through the building with press buttons, on all floors, so as motors can be started or stopped at any time by any one, by means of a code of signals, which are posted at each press button. Speaking tubes also go from office to generator room, and from thence to building on all floors. Three bells calls engineer to speaking tube always.

The offices are directly over generator room. The main building when first built was a wooden structure, and power was conveyed to building by a long line of shaft, as referred to earlier in the description. This was burnt about five years ago, and as the engine room was saved they put up a generator room, and installed the electrical equipment as described, and built a new grain house of solid cement reinforced with steel, using 5,000 lbs. of cement and an immense quantity of steel.

The house is 160 ft. high and 80 ft. wide and 180 ft. long and has 55 bins 14 feet sq., and running in depth from 60 to 75 ft. and has a capacity of 500,500 bushels of grain. In the centre of the building on the north side and facing the harbor is the marine leg, 75 feet high and weighing 19 tons, with an endless rubber belt with two rows of gallon and a half buckets numbering 256. This is driven by motor No. 8, which is 65 h.p., and is located on the bin floor about 90 ft. from the ground. A 25 h.p. motor (No. 3) C.G.E. drives the winch which lowers and raises the leg when unloading boats.

Besides the marine leg is the passenger elevator which runs to second top floor and is operated by motor No. 5, it being a 5 h.p. and located on a steel frame along with drum, etc., above the second floor.

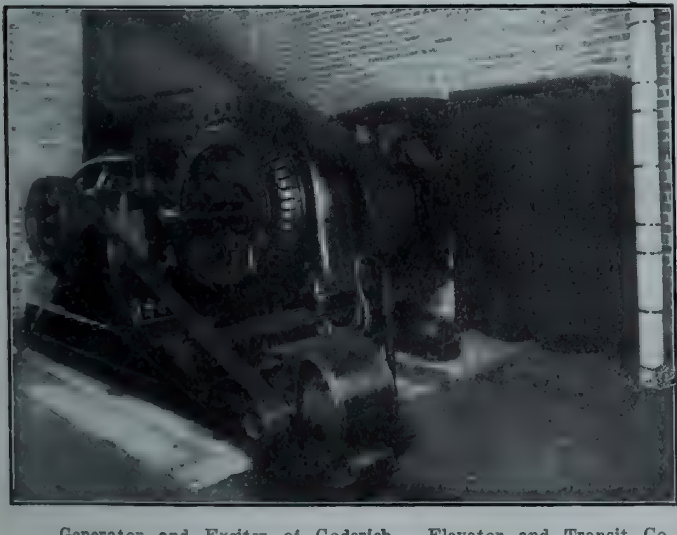
On the ground floor are located motors Nos. 6, 7, 3, and 4. No. 4 runs a car puller for placing G.T.R. cars for loading and is a 15 h.p., Nos. 6 and 7 run the east and west lower conveyers for conveying grain from bottoms of bins when loading cars out of the the house, as they dump the grain into the boots of the main elevator from whence it goes to top storey and then to the scales. A small enclosed switchboard is also located on ground floor to handle lights on all the circuits on lower floor, tower and stairway.

On ground floor are located a pair of two cylinder marine reversible engines, with cranks set at an angle of 90 degrees, one ahead of the other so they cannot centre. These are used for running the steam shovels in the boat hold, to draw the grain up to the marine leg and are fed by a 4 inch main from boiler room.

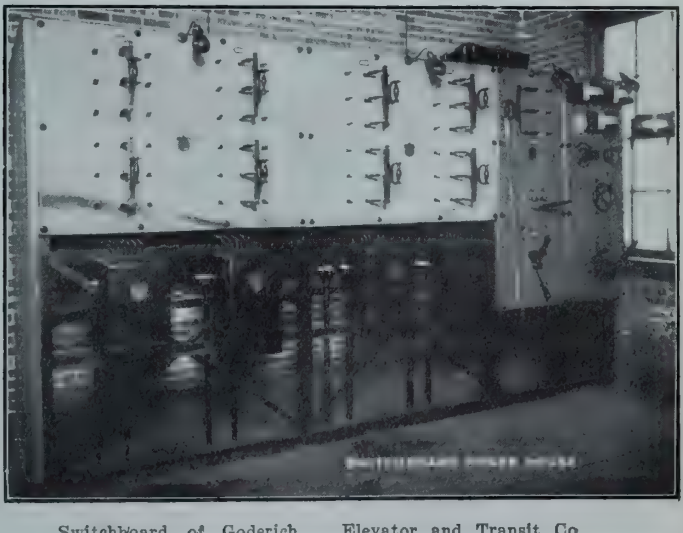
On the 4th floor two 10 h.p. motors, Nos. 1 and 2, are located to drive the conveyor belts which carry the grain from the scales and into a distributing machine, which then empties it into whatever bin spouts are set for. These belts are rubber, each 3 feet wide and 200 feet long. No. 8 motor is also located on this floor. On this floor are spouts leading to G.T.R. and C.P.R. tracks, and they can change them from conveyor belts to either line and drop it direct from weigh scales to cars, as they always weigh a car load at one time in one scale. When doing this, motors 1 and 2 are shut down.

Next floor up is scale floor where two 72,000 and one 84,000 lbs. scales are located, made by Fairbanks Scale Co., and are in charge of Samuel J. Lynn, weighmaster.

The next floor up is the garner floor where three large steel bins (with a capacity equal to scales directly underneath them) are located. They are used to catch grain from the elevators while the scales are empting. Next floor up is the top floor and here are located Nos. 9 and 10 motors. No. 10 is 100 h.p. and is belted to a line shaft to which is connected friction clutches and pinion drives, to run the two main elevating legs, which convey the grain from the basement (where the marine leg drops it) to the top floor



Generator and Exciter of Goderich Elevator and Transit Co.



Switchboard of Goderich Elevator and Transit Co.

and empties it into the garners on second floor and from thence to scales, etc. No. 9 is a 50 h.p. motor driving a single elevating leg, which helps carry grain from ground floor to scales, when they are empting bins.

These motors are all A.C.B. induction motors, excepting No. 3 which is a 25 h.p. C.G.E. They also have a 15 h.p. C.G.E. and a 10 A.C.B. motor for reserve. This building is located at the edge of the dock towards the east end of the harbor and rests on solid rock, with iron spiles (hollow) being put down and afterwards filled with concrete.

On ground floor the pillars under bins are 3 ft. square. An emergency switch is placed at car puller in case of accident. There have been 180,000 bushels unloaded there in 14 hours.

A Study in Heat Transmission to the Water in Tubes

Experiments Dealing with the Transmission of Heat to Water in the Tubes as Affected by the Velocity of the Water—Its Relation to Boiler Tubes.

(Continued from June Issue.)

The curve taken with a steam temperature of 330 deg. in the jacket is almost a straight line. The other curves also tend to assume a straight line at the higher velocities, which means at the higher temperature differences. It is possible that the former curve would rise suddenly at the smaller velocities.

In Fig. 3 is also shown the straight dashed line indicating the constant conductance of the metal of the tube, which is 1.204.

In column 17 of the table are given the conductances through tube and film on the water side. These were computed by taking the reciprocal of the sum of the reciprocals and the conductances of the tube and of the film on the water side; the former of which is constant and equal to 1.204, while the latter is obtained from column 16 of the table. The conductances of tube and film are shown in Fig 4 plotted against the velocity of flow of the water.

The curves of Fig. 5 show the relation between the velocity of the flow of the water in the tube and the total heat transmitted per minute per square foot of mean tube surface. Curves of Fig. 6 show the relation between the velocity of the water and the B.t.u. absorbed per pound. The curves of Fig. 2 were obtained by a set of separate experiments to investigate the rise in temperature of the water along the tube. The temperatures in the tube were taken by means of a thermocouple placed in the end of a long glass tube which was pushed through a perforated cork placed in the end of the water or boiler tube. Beyond the end of the glass tube and ahead of the thermocouple junction, a small baffle was placed so that the mean temperature of the water might be obtained. It will be seen that the rise in temperature is proportional, within the limits of these experiments, to the distance from the entering end of the tube.

In Fig. 7, the temperature of the steam surface of the tube is plotted against velocity of water in feet per second. These curves by their uniformity seem to indicate the reliability of this method of experimentation.

Fig. 8 is a graphical representation of the temperature gradient through the film on the steam side, the tube and the film on the water side. The values corresponding to the maximum and the minimum velocities, as obtained in the experiment, have been plotted for the steam temperatures of 330 deg. and 274 deg. maintained in the jacket. Fig. 8 illustrates the increased temperature gradient due to the increase of the velocity of flow of the water in the tube. Fig. 8 is interesting in several respects. It illustrates very clearly the effect and importance of the film resistance in all heat transmission problems. It further shows that the film resistance of the metal in the case of tube and plates is much less than the resistance of the films. It may even be used to illustrate why it is possible to lubricate a gas engine with cylinder oil having a flash point of 700 deg. F. while the temperature of the gases in the cylinder may be close to 2500 deg. F.

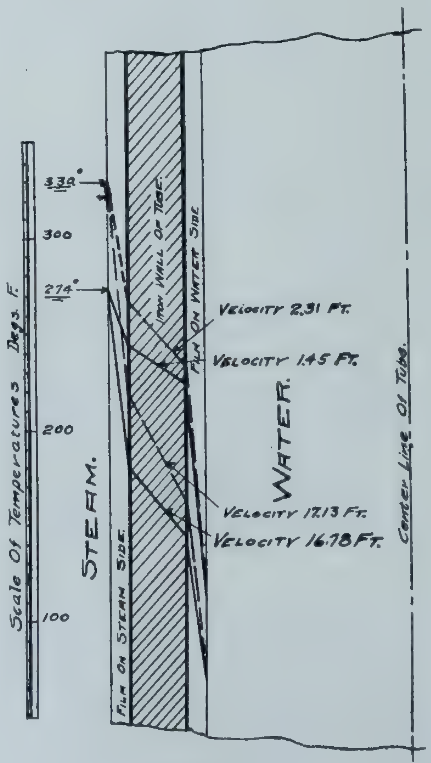


Fig. 8.

Conclusions.

The limited nature of these experiments forbids the drawing of any general conclusions other than those already known. The principal interest lies in the development of a method which seems to offer a very desirable means of studying the effect of the variation of the velocity of the flow of gas, steam or water on the rate of the flow of heat through tubes, plates, etc.

In order to investigate this subject of the effect of velocity on heat transmission more carefully, means should be provided for maintaining the tube and the water at a constant temperature, while varying the velocity of the latter. In studying the effect on the heat transmission of the velocity of gases over the tube, means should be provided for varying the velocity of the gas, while maintaining a constant temperature of the gas and tube.

The effect of the formation of steam on the walls of the tube, as it approaches the condition in steam boiler practice, should come in for consideration. It is probable that the effect of rapid agitation of the water in a tube in which steam is forming, especially in large quantities, will be much greater on the heat transmission through the tube to the water, than would be the case in a tube in which no steam was forming, owing of course, to the breaking up and washing off of the steam bubbles from the side of the tube. It might be well to point out here that it is the rate of agitation, and not necessarily the velocity of the water, that produces the change in heat transmission. The velocity in feet per second has been used for the reason that it is the only definite quantity available to express this rate of agitation. It may be, to a certain extent, a measure of the rate of agitation, but it is not necessarily so. The rate of agitation may be defined as the number of times per second that each particle of water comes in contact

TABLE 1

No.	Temperatures in Degrees F.										Water		Conductance			
	Entering Water Av	Leaving Water Av.	Rise	Steam in Jacket	Steam Wall of Tube. Mean	Drop from Steam to Wall of Tube	Drop through Metal of Tube	Water Wall of Tube	Water in Tube. Mean	Drop from Wall of Tube to Water	Weight of Water per Minute	Velocity of Water in ft. per second	B. t. u. per sq ft. per Minute	Conductance of Film on Steam Side	Conductance of Film on Water Side	Conductance of Tube and Film on Water Side	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
1	56.92	66.75	9.83	210.9					61.8		318.0	16.07	1615				A
2	58.20	70.25	12 05	210.9					64.2		263.0	13.29	1638				
3	58.55	71.90	13.35	210.9					65.2		236.0	11.93	1628				
4	58.63	73 20	14.57	210.9					65.9		204.3	10.33	1538				
5	58.20	74.82	16.62	210.9					66.5		176.0	8.90	1512				
6	57 89	75.28	17.39	210.9					66.6		147.0	7.43	1322				
7	58.20	78.52	20.32	210.9					68.4		120.0	6.07	1260				
8	58.29	84.49	26.20	210.9					71.4		81.1	4.11	1098				
9	58 37	92 00	33.63	210.9					75.2		55.1	2.80	957				
10	58.91	108 40	49 50	210 9					83.7		29.0	1.48	741				
11	60.10	175.49	115.40	210.9					117.8		7.12	.37	425				
1	58.55	73 35	14.80	273 6	181.2	92.4	35.2	146	65.9	80	331.7	16.78	2537	.458	.528	.367	B
2	58.32	78.12	19.80	274 4	202 0	72.4	34.7	167	68.2	99	244.4	12.37	2501	.576	.421	.312	
3	58.15	75.45	17 30	273 7	193.2	80.5	36.5	157	66.8	90	294.3	14.89	2631	.544	.487	.347	
4	57.90	80.94	23 04	273 9	203.0	70.9	33.1	170	69.4	100	200.5	10.15	2387	.561	.399	.300	
5	58 03	85 83	27.80	274.1	208.0	66.1	31.0	177	71.9	105	155.7	7.89	2237	.561	.354	.273	
6	58 10	92 88	34 78	274.1	211 0	63.1	28.9	182	75 5	106.5	116.0	5.88	2083	.550	.325	.256	
7	62 87	120.46	57.59	274 1	235.0	39.1	23.8	211	91.7	119	57.6	2.94	1715	.730	.240	.200	
8	63.28	108.50	45 22	274 5	227.0	47 5	24.8	202	86.0	116	76.4	3.89	1786	.628	.256	.211	
9	63 73	145.90	82 17	274.5	239 7	34.8	21.0	219	105.0	114	35.7	1.84	1516	.724	.222	.187	
10	67 55	162 20	94.65	274.4	213	31.4	19.0	224	114.0	110	28.0	1.45	1369	.724	.207	.177	
1	67.54	85.00	17.46	306.6	219 9	86.7	43.6	176	76.3	100	348.4	17.64	3144	.605	.525	.365	C
2	67 54	87.19	19.65	306 6	219.0	87.6	43.2	176	74.4	102	306.4	15.50	3112	.591	.508	.357	
3	67.54	93.30	25.76	306.5	230.5	76.1	41.6	189	80.4	109	226.0	11.43	2998	.655	.459	.333	
4	58.73	107.69	48.96	306 8	246.4	60.4	36.7	210	83.2	127	104.7	5.33	2649	.731	.347	.269	
5	58.89	118 05	59.16	307.0	252.3	54.7	34.7	217	88.5	129	81.8	4.17	2501	.761	.322	.254	
6	59.27	129.70	70 43	307.0	255.7	51.3	31.3	224	94.5	123	62.0	3.17	2256	.731	.291	.234	
7	59 52	154.35	94.83	307 4	261.1	46.3	28.8	232	107.0	125	42.5	2.19	2081	.750	.278	.226	
1	57.67	80 50	22.83	330.2	220	110.2	55.2	165	69.0	96.0	338.4	17.13	3995	.606	.694	.440	D
2	57 67	83.88	26.21	330.0	229.4	109.6	52.0	177	70.8	106.0	277.4	14.05	3756	.621	.591	.396	
3	58.28	90.92	32.64	330.0	233.1	96.9	47.8	185	74.6	110.0	205.0	10.39	3455	.594	.524	.365	
4	58.17	97 90	39 73	330.2	241.8	88.4	45.1	197	78.07	119.0	158 7	8.06	3260	.614	.457	.331	
5	58.50	120 60	62 10	330.2	257.4	72.8	37.0	220	89.5	130.5	83.3	4.25	2672	.611	.340	.265	
6	58 89	161.50	102.61	330.2	267 1	63.1	32.8	234	110.2	124.0	44.7	2.31	2370	.625	.318	.251	

with the tube or with the film on the tube if we consider that the film is indestructible, although it is more likely that the film is in a process of continuous renewal. In the case of the present experiments, it is probable that if elaborate baffles had been placed in the tube, the heat transmission for the same velocity of flow would have been increased. Also, if the stream of water on entering the tube had been given a rotary motion, the heat transmission would have been increased while the velocity through the tube remained constant.

Steel Used in the Manufacture of Steam Boilers

An Engineer Should be Fully Acquainted with his Boiler---A Knowledge of the Steel from which Boiler Plates are Made is Important.

By George D. Fowler [*]

Steel is variously defined by acknowledged authorities. The metal known on the market and to the trade as steel, cannot be completely and satisfactorily classed under any definition yet proposed.

The term includes, as formerly accepted, all impure irons which, in consequence of the presence of other elements, have the property of hardening by sudden cooling from a high temperature and of taking a definite "temper" or degree of hardness by a modification of temperature and which may also be forged.

It has been more recently proposed to define steel as a compound consisting principally of iron, which has been rendered homogeneous by fusion. Still another definition is "iron recarbonized." The first definition is based upon composition and properties ; the others upon the method of manufacture. The latter compels the engineer to ascertain the history of the metal before he can give it a name ; the trade has practically adopted this last method of nomenclature.

An international committee appointed at the instance of American Institute of Mining Engineers in the year 1876, recommended the following nomenclature :

I. That all malleable compounds of iron with its ordinary ingredients, which are aggregated from pasty masses, from piles, or from any forms of iron not in a fluid state, and which will not sensibly harden and temper, and which generally resembles what is called "wrought-iron," shall be called "weld-iron," (which in German is called schweisseisen).

II. That such compounds, when they will from any cause, harden and temper, and which resembles what is now called "puddled-steel," shall be called "weld-steel," (which in German is called schweiss-stahl).

III. That all compounds of iron with its ordinary ingredients which have been cast from a fluid state into malleable masses, and which will not sensibly harden by being quenched in water, while at a red heat. Shall be called "ingot iron," (which in German is called fluss-lisen.)

IV. That all such compounds, when they will from any cause so harden, shall be called "ingot steel," (which in German is called fluss-stahl.)

As arranged by Herr Wedding, the following is the scheme of the system :

- Iron
  - I
    - Forgeable, Difficult to melt.
      - Obtained in a fluid state. A. Ingot iron
        - Hardening. 1. Ingot Steel
        - Non-hardening. 2. Ingot Iron.
    - Forgeable iron
      - Obtained in a non-fluid state. B. Weld iron
        - Hardening. 3. Weld steel
        - Non-hardening. 4. Weld iron
  - II
    - Notforgeable, easy to melt
    - Pig iron
      - With carbon only. C—White pig
      - With graphite. D—Grey pig.

There may be added also : "remelted" pig-iron (cast iron), and "remelted" steel of every description (cast steel).

The grades are practically distinguished quite readily, thus :

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[*] Boiler Inspector, The Boiler Inspection & Insurance Co., of Canada.

I and II by their capability of being easily forged or otherwise ; A and B by their characteristic fracture, and C and D by their color. Or, by chemical analysis according to Herr Wedding, the percentage of carbon will be :

Iron	I—Contains from 0.0 to 0.3 per cent. 2 and 4—Contains from 0.0 to 0.6 per cent. II—Contains from 2 to 3½ per cent.
Steel	1—From 0.6 to 3 per cent. 3—From 0.6 to 3 per cent.

The American Institute of Mining Engineers, when discussing the report of the International committee on nomenclature, assented to the following as a correct "commercial nomenclature," while recommending the use of the proposed one, in papers written by members :

- Iron.
  - Wrought
    - Bloom
      - Catalou
      - finery
    - Puddled
      - Bars
      - Plates
      - Beams
    - Steel
      - Blister
      - German
      - Shear
      - Puddled
  - Cast
    - Not Malleable
      - Pig iron
      - All ordinary castings.
    - Malleable
      - Castings, annealed and decarbonized in oxides
      - Steel
        - Castings not highly carbonized.
        - Crucible.
        - Bessemer or pneumatic.
        - Open hearth
          - Siemens-Martin.
          - Siemens by pig-iron and ore process.

The metals called steel, grade into each other by imperceptible variations. Hand-puddled iron has the properties of crucible steel and ingot metals, which are considered by the trade as indisputably steel ; while the product of the Bessemer, and other processes yielding ingot metal, is, when containing very little carbon, sometimes as fibrous and silky in texture as common wrought iron.

Steel, made at one of the largest works in France, is classified into three divisions : A, B and C. Of these A covers all cheaper grades of steel, low in carbon, such as are produced by the Bessemer and the Siemens-Martin processes, and the low grades of crucible steels ; division B includes steels of ordinarily good quality ; while division C includes the purest and best metals, such as are made from the best Swedish ores, from charcoal pig, and by the crucible process.

Each division thus designated by the degree of purity of the metal, is subdivided according to "temper" or hardness, and the several grades of temper are determined by a mechanical rather than by a chemical test. The basis is the measured elongation of specimens of standard size ruptured by tension.

The addition of carbon to iron, hardens the metal, and decreases its ductibily and its malleability, and renders it more fusible and less resilient. When in higher proportions than one-half per cent., and less than two per cent., it makes a steel capable of being hardened and of taking temper.

An Austrian official classification of grades of steel is the following :

No.	Carbon	Characteristics	
	Per cent		
1	1.58 to 1.38	Will not weld	Seldom used
2	1.38 to 1.12	Will weld	Used for hard tools
3	1.12 to 0.88	Welds fairly	Used for chisels, etc.
4	0.88 to 0.62	Welds quite easily	Used for files, etc.
5	0.62 to 0.38	Welds readily	Used for rails and tires
6	0.38 to 0.15	Will not temper	Used for boiler plates
7	0.15 to 0.05	Will not temper	Substitute for iron

One of the largest makers of steel-plates in Europe divides all steel into four classes :—

1st Class—Extra mild steels : carbon, 0.05 to 0.20 per cent.; tensile strength, 25 to 32 tons per square inch, and extension, 20 to 27 per cent. in 8 inch of length. These steels will weld, but do not temper. They are used for boiler-plates, ship-plates, girder-plates, nails, wire, etc.

2nd Class—Mild steel : carbon, 0.20 to 0.35 per cent.; tensile strength, 32 to 38 tons per square inch, and extension 15 to 20 per cent. in an 8-inch piece ; is scarcely weldable ; hardens only a little. It is used for railway axles, tires, rails, guns and other pieces exposed to heavy strains.

3rd Class—Hard steel : carbon, 0.35 to 0.50 per cent.; tensile strength, 38 to 46 tons per square inch ; extensions, 15 to 20 per cent ; does not weld ; but may be tempered. It is used for rails, special tires, springs, guide-bars of steam engines, pieces subject to friction, spindles, hammers and bumpers.

4th Class—Extra hard steel : carbon, 0.50 to 0.65 per cent.; tensile strength, 46 to 51 tons per square inch ; extension, only 5 to 10 per cent.; does not weld, but may be strongly tempered. It is used for delicate springs, files, saws, and various cutting tools.

Steel Making Processes.

The steel-making processes may be divided into three classes : (1) that which includes those steels made of malleable or wrought iron, carburetted ; (2) that which comprehends all processes in metal rich in carbon, such as common cast iron is partially decarbonized, and (3) that in which highly carburetted iron is first completely decarbonized, and then recarbonized to the proper degree in a single process.

Many steel-making processes are known, and several are extensively practiced. Those best known and which furnish nearly all the steel found in the market, are the Crucible, the Bessemer, and the Siemens-Martin processes. Direct reductions from the ore, and the manufacture of steel by puddling, are less generally practiced.

Crucible steel, as made by melting blister, or cemented steel, to give it a homogeneous character, is the standard steel for fine tools. This process was introduced in Great Britain, and was probably invented by Benjamin Huntsman, about the year 1770. He was then living near Sheffield.

The pneumatic method of steel-making, generally known as the "Bessemer-Process," is perhaps the most extensively practiced, and the most productive, by far, of all-known methods of maffking ingot metals.

It has, for many years, been known that the agitation of molten cast-iron in presence of oxygen, will produce combustion and the removal of carbon, and the reduction of the cast iron to a state of malleable iron or steel. The Bessemer process secured such an agitation and a very thorough mixture of the fluid iron with the oxidizing atmosphere, by causing the latter to stream up through the molten mass in innumerable minute bubbles. The rapid combustion thus secured, is sufficient to supply all heat needed, not only to retain the metal in a fused condition, but also, so rapidly and so greatly to elevate its temperature during the operation, that the product, even when entirely deprived of carbon, remains a perfectly fluid wrought iron in the converting vessel.

This process was invented independently by two different men, by Henry Bessemer, in Great Britain, and by William Kelley in the United States. Patents were issued to both by the U. S. Patent Office, and their interests were combined when the manufacture was established. Bessemer's patent dates from November, 1856, and Kelley's from January, 1857. At first, Kelley forced air under high pressure, downward into the molten mass of metal, in comparatively few and large streams.

Bessemer began in a somewhat similar way, treating steel in crucibles. In both cases, the metal was converted so slowly that chilling took place before the work was completed ; but, when the same operation was conducted in the more effective method now familiar to engineers, it became at once a more practically useful process, and furnishes a large amount of steel boiler plates.

The Siemens-Martin process is of the "open hearth" method, and is the most practical one of producing large ingots. By the old method the melting of a ton of steel often required three to four tons of coke, but by the Siemens-Martin furnace, the work is done readily with a ton or less, of the cheapest fuel. Steel, melted on the Siemens' open hearth, requires the consumption of three quarters of a ton, or less, of fuel, to a ton of metal, and the rapidity of melting is much greater than in pots. The high temperature required for melting steel has precluded the use, to a considerable extent, of the ordinary form of reverberatory furnace, and the Siemens furnace is the only one which has, up to the present time, been adopted for this work with satisfactory and general success.

This open hearth method of making steel as proposed by C. W. Siemens, was first practiced in France by Messrs. Martin, in 1865, and is generally known as the Siemens-Martin process. This method is sometimes regarded as one of decarburization of cast iron by the addition of uncarburized metal. It is perhaps, more correctly, a method of imparting a definite proportion of carbon to wrought iron by mixture, in fusion, with cast iron. It is extensively practiced and is the principal, and, as yet, practically the only competitor with the Bessemer process in the production of soft and low carbon steels.

For this process the bed of the furnace is given a form somewhat resembling that of the puddling furnace, and the lining, or bed, is made of selected clean sand, containg some alumina, or magnesia.

A charge of scrap iron, or old rail-ends, either iron or steel, is introduced after the furnace has been brought up to a full white heat, and to this is added the required amount of cast-iron. The weight of a charge is from 8 or 10, to 60 or more tons. With a 40 ton furnace, a product of 7,000 tons, or more, annually, has been obtained.

The pig and scrap iron and steel are heated separately, before charging into the steel furnace. A charge of about 2,000 lbs. of the heated pig metal, is first placed on the hearth and melted down. The scrap steel, and wrought iron, heated to a white heat, are next added in charges of 440 lbs. at half hour intervals, each charge being melted down and thoroughly incorporated in the bath before the next is added.

Decarbonization becomes complete in about 6 or 7 hours, and the mass becomes pasty after the fusion of the proper amount of wrought iron.

Recarbonization is then effected to the right extent for boiler-plate steel, by the addition of cast iron, which is fused in with the molten mass.

The bath is then covered with a slag of blast-furnace cinder, and the metal is kept fused any desired length of time, while adjusting its quality. The charge is melted down under an oxidizing flame, and the carbon is thus partly removed by burning out, and the exact proportion required is then secured by dilution with malleable metal. The molten cast metal forms a liquid bath on the hearth, into which the wrought iron gradually disolves. The metals having thoroughly become fused, the process is continued until samples taken from the furnace and tested, show the desired quality, or until they indicate complete decarburization. In the latter case, the "spiegeleisen," or other manganese-bearing metal, is added, and tests of samples are again taken to determine quality.

If the metal is not yet of the exact quality wanted, then the addition of cast iron, or spiegeleisen, or of wrought iron is continued, as required, until the steel is found to be of precise character demanded, and it is then tapped off into ingot molds, and finally sent to the rolling mill.

This process of making mild steel for boiler plates, has some peculiar and important features of advantage over the Bessemer process. The steel lying on the open hearth, under a flame which may be made oxidizing, deoxidizing, or neutral, at pleasure, may be sampled at convenience, retained in fusion any desired length of time, and treated in any way that may be necessary in the modification of its quality.

Rolling Mill.

Having described at some length the several methods of steel-making, more particularly the one of making steel for boiler plates—the open hearth process—we now come to the rolling-mill. The metal is first treated in a "Puddling-Furnace," until it changes from a pastry mass to a "puddle-ball." Millwork comprehends the several processes by which the puddle-ball is converted into the finished plate. The ball is transferred directly from the puddling furnace to be squeezed by the squeezer and there compressed until the liquid cinder is forced out, much on the principle that water is forced or squeezed from a sponge by the hand ; and the ball is compressed into a dense billet or bloom of steel. It has then the form not unlike a cylinder, and is at once carried to the rolls and sent through.

The bloom is rolled and re-rolled a number of times until it is reduced to the shape of a plate. This repetition of rolling greatly improves its quality, increases the uniformity of the product, and secures greater homogeneousness, by removal of some of the carbon and silicon left in the puddle-ball.

The quality of the plates produced, depends upon the original quality of the metal, upon the care taken in rolling, and upon the cleanliness of surfaces which are welded together in the process. The manager of the rolling-mill tries to see that the puddling is properly done, that the puddle-ball is made up as free as possible from cinder, that the cinder in the ball when taken from the puddling-furnace is worked out as completely as possible under the hammer, or in squeezers, and that the steel is carried through the roughing-rolls while still at a proper temperature, that the re-rolling is done at a good heat, that all surfaces are perfectly clean where they are to come in contact to be welded together, and that cinder and scales of oxide are not allowed to collect on the metal, or on the rolls, where they may produce roughness or depression in the finished surface of the plate.

A complete and rigid system of inspection and individual responsibility for work done should be instituted and kept up in every rolling mill, especially so when the production is plates for steam boilers.

There is much to be said in connection with and concerning the character and quality of boiler-plates, such as tensile strength, elastic limit, reduction of ara, elongation, ductility, and homogeneousness, and these will be gone into later, in connection with the making of the plates up into steam boilers.

PRESENTATION.

William Syrie, who is retiring as foreman of the boilermaking department of the Waterous Engine Works Co., Brantford, was presented with a silver tea service at his home by representative foremen and employes who waited on him. A pleasant evening was passed, refreshments being served, speeches made and music redered. Henry Simpson read an appreciative address signed by T. R. Logan, Henry Simpson and Geo. Brenner.

The Waterous Co. on the occasion of his retirement, also presented Mr. Syrie with a substantial cheque as a mark of their appreciation of his services.

W. Mahlon Davis, of Berlin, Ont., has been appointed City Engineer of Prince Rupert, B.C., at a salary of $5,000. Mr. Davis is a member of the Canadian Society of Civil Engineers and has a large consulting practice in Ontario, which includes the engineering work of Berlin.

Power at 25 Cycles vs. 60 Cycles in Toronto

By C. L. GULLEY, B.A.Sc.

The conditions that to-day exist in the central station business in the City of Toronto, are not new to the electrical profession, as they are being experienced or discussed in every city of any size in Canada and the United States. The electrical world has seen advances in the last few years that at first seemed incredible, and at which people still wonder. Among these advances is one which is attracting the attention of the citizens of Toronto, possibly more than any other; the writer has reference to the enormous strides taken in the development of the transmission line. The reason for this is directly due to the degree of perfection to which the insulation problem has been worked. Not many years ago 110,000 volts was considered by electrical engineers as impracticable, owing to the difficulties experienced in obtaining an insulating material, which would stand up under such a strain. However, these difficulties have been met and overcome, and to-day, as a result, we have entering the City of Toronto, a transmission line, which will work under a pressure of 110,000 volts.

Power, in electrical units, is the product of volts and amperes; so that, within limits, for a definite amount of power transmitted the higher the voltage the smaller will be the current, which means the line loss will be smaller as the line loss, which mainly consists of copper loss, depends upon the amount of current flowing. Thus, any means of lessening the current is immediately substituted, and as can be seen from the above statement the only way to do this is by increasing the voltage under which the line is being worked. Also, as the current is decreased the cross-section of transmitting copper can be decreased, which means a very considerable saving in the line copper. Also as the copper is decreased, the weight of the line is decreased, causing a decrease in the size, strength and number of the towers. On the other hand, as the voltage is increased (i.e. decreasing the current for a definite amount of power transmitted), the cost of insulating the line increases very rapidly. Thus, as we evade one source of expense to the first cost of the line we encounter the other. However, for any large amount of power transmitted on a low voltage line, the line loss as well as the cost of the copper and towers necessary would be enormous, and would more than balance the increased cost of insulating the high voltage line.

The 25 cycle problem, which is being worked out in Toronto is one which depends directly upon the transmission line, as power can be transmitted more cheaply, i.e., with less line loss, at 25 cycle per second, than at 60 cycle per second. Anything that will lessen line loss without materially affecting line cost is at once grasped.

Line loss depends upon the resistance and the inductive reactance of copper wire, and the charging and leakage current. The last two depend npon the voltage of transmission.

From the table of physical and electrical constants of copper wire for Matthiessen standard wire at 60 degrees Fahrenheit for transmission line calculations, as found in the Standard Handbook for electrical engineers, we find a very considerable difference in the charging current and inductive reactance, when calculated for 25 and 60 cycles.

Table of Physical and Electrical Constants for Copper Wire.

Frequency in cycles per sec.	Size of wire, B. and S.	Interaxial distance in inches.	Resistance per mile of one wire in ohms.	Inductive resistance per mile of one wire in ohms.	Charging current in amperes per mile per 1000 volts between wire & neutral.
	No.				
25	0000	72	.2540	.3033	.00243
60	0000	72	.2540	.7278	.00584

The writer has chosen the constants affected by the frequency, and in each case it is found that the line loss will be decreased by transmitting at 25 cycles instead of 60. The resistance of the copper wire and the leakage current are unaffected, but the inductive reactance and the charging current are each decreased 58 per cent.

Before the days of the long transmission lines, alternating current was practically standardized at 60 cycles per second. However, now that the citizens of Toronto are being supplied with power from Niagara Falls at 25 cycles per second, it means that the central station man must either install special motor generator sets to change the frequency or arrange to have the 60 cycle apparatus removed and replaced by similar 25 cycle machines. In the case where there are a great many consumers already using current at 60 cycles per second it is a better proposition for the central station man to install his frequency changes and to stand the increased loss in the changing of the current, and in distributing to his customers, but where the consumers are comparatively few and scattered over large areas it is better for him to have the system changed as a few customers can be changed with very little trouble for the customers or for him. On this account we find the Toronto Electric Light Company changing its current in the outskirts of Toronto, where industrial power-using establishments are scattered.

One great drawback to 25 cycle current is that it will not operate satisfactorily an arc lamp. Where an arc must be used, as in a moving picture theatre in which place a most intense light is necessary, it means the installation of a motor generator set or better, a mercury rectifier set. A mercury rectifier set is preferable for it works at an efficiency of 93 per cent. and 97 per cent. against an efficiency of 70 per cent. to 80 per cent. for the motor generator set. The upkeep of such a rectifier, however, is against it, as there is an expenditure of $30 to $40 per annum for bulbs, the life of a bulb being 800 to 1,200 hours, whereas, with a motor generator set, neglecting burn-outs, etc., there is no direct outlay.

For incandescent lighting the two currents are interchangeable. Upon observing minutely a lamp burning on 25 cycle current one can detect a flickering, which is absent in a lamp burning on 60 cycle current. This flickering is generally considered to be so slight as to be harmless to the eye.

Motors designed for 25 cycles do as good work as those designed for 60 cycles, the former, however, being more expensive, owing to the fact that more iron and copper are necessary. The no-load speeds obtainable with 25 cycle motors are 1,500, 750, 500, 375, etc., r.p.m., while those with 60 cycle motors are 3,600, 1800 1,200, 900, etc., r.p.m., downwards. Thus, we see in the case where a direct connected motor generator is essential or where there is a direct connected tool, the highest permissable speed with 25 cycles is 1,500 r.p.m., which may or may not fill the requirements. Where connection is made by means of belt and pulleys any difficulties of this nature can be eliminated by varying the sizes of the pulleys.

Then to sum up:—power alternating at the rate of 25 cycles per second, is much more cheaply transmitted and distributed than power alternating at 60 cycles per second; to distribute at 25 cycles per second eliminates the use of frequency changer sets in the central stations; and with the exception of arc lamps one operates electrical appliances as well as the other.

The Machinery and Equipment of a Steel Suction Dredge

An Account of the Dredge under Construction in Toronto at the Polson Iron Works, for the Great Lakes Dredging Company, Port Arthur.

This large suction dredge is nearing completion in the yards of the Polson Iron Works, Toronto, for the Great Lakes Dredging Co., of Port Arthur. The contract was divided between the Polson Iron Works and the Bucyrus Co., South Milwaukee, Wis., the former company doing the greater portion of the work.

The vessel, Fig. 1, is of steel construction throughout. In length, it is 125 feet, with a 40 ft. beam, and the main hull is 9 feet deep, will draw, when completed, about 5 ft. 6 in. of water. This main hull has been divided into two longitudinal, and three transverse, water tight bulk heads, making 12 water tight compartments. This precaution has been taken to prevent sinking of vessel in case of accident to shell, as two, or three compartments might be filled and the dredge still remain afloat.

The main deck house is 96 ft. long by 32 ft. wide, and is 9 ft. in height. In this and the main hold, are all the power mechanisms of the boat. On the forward part of the roof of this main deck house (not completed when photograph was taken), is the operating cabin, behind which is a steel house 40 ft. x 22 ft., for the living quarters of the crew.

Cutter Head.

The cutter head is a single open hearth steel casting, 5 ft. 10 in. in diameter by 4 ft. 8 in. long, and consists of eight extra heavy blades, radially set from a hub at the end and running back spirally to a 3 in. by 8½ in. back ring to which they are cast. This cutter head is mounted on a forged steel shaft, rough turned between bearings.

The cutter shaft is driven through three sets of gears by a 10 x 14 horizontal, double reversing steam engine, in the hold of the dredge.

The suction ladder shown in Fig 1 at A is 57 ft. long and 16 ft. wide at the inner end, tapering to the cutter head, and is of exceptionally heavy design consisting essentially of two heavy plate girders strongly cross-braced. The ladder is supported at its inner end by two trunnion bearings, one of which is hollow, and forms the suction pipe connection to the pumps. These trunnion bearings have removable caps, so that the ladder may be completely removed without disturbing the rest of the machinery. The ladder is suspended from a structural steel jib which in turn is suspended from a structural steel A-frame (the latter shown at B, Fig. 1), both of which are pin-connected to the deck. The hoisting tackle consists of a continuous rope with two leads to the drum, thereby equalizing the strains on the sides of the block. The lower block is so arranged that it is always out of the water, even in the ladder's lowest position.

Suction and Discharge.

The inboard suction and discharge pipes consist of 20 in. diameter, lapwelded, steel pipe, ½ in. thick, connected to the pump by steel casting reducers. To insure safety from sinking in case the discharge pipe should become ruptured, the latter is jacketted. All elbows in both suction and discharge pipes are open hearth steel castings, and are provided with man-holes for the ready removal of obstructions such as stones and stumps.

The centrifugal pump, Fig. 2, which is unlined, has a 78 inch diameter runner. Both suction and discharge orifices are the same in size, 22 inches in diameter. The casing is a single open hearth nickel-chrome steel casting, with the maximum thickness in the region of the greatest wear, and it is braced by radial ribs extending around the shell from the suction head flange to the similar flange on the back. As these ribs increase the thickness of the shell available for wear, the life of the casing is increased. The front and back heads, which are also unlined, are steel castings. The back head has brackets cast on to be attached to the base to which the pump shaft bearings are attached. The runner is a single

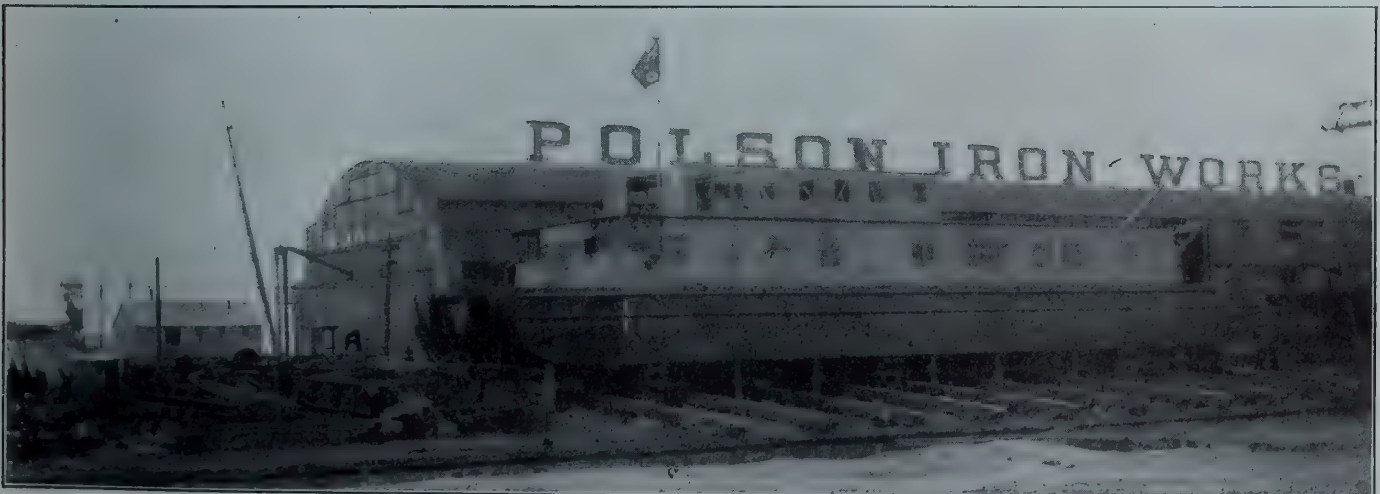


Fig. 1—New Dredge Built at Polson Iron Works, Toronto.

steel casting of shrouded type with five curved arms. The pump shaft is made in two parts to facilitate the removal of the runner from the casing when so desired. These shaft parts are connected by large clamp couplings. The section of the shaft next to the engine has three integral thrust collars with adjustable thrust bearings of the horseshoe type.

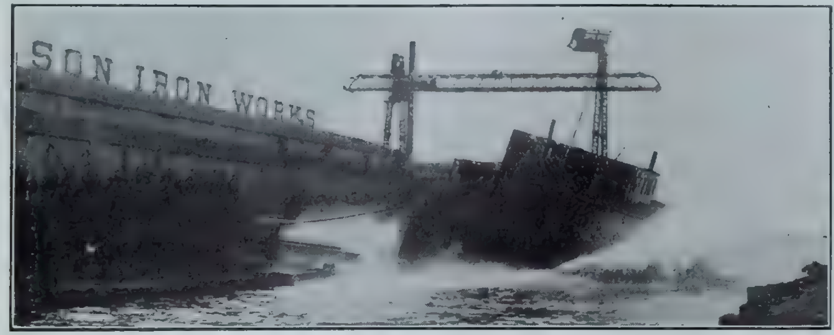


Fig. 3.—Launching New Dredge at Polson Iron Works, Toronto.

Engine and Pumps.

The pump is directly connected through this shaft to a vertical triple expansion marine type, non-reversing engine, Fig. 2, with cylinders 15 in., 22 in. and 36 in. in diameter and an 18 in. stroke, capable of running 200 r.p.m., and of developing 700 i.h.p. at that speed with 190 lbs. steam. This engine was supplied by the Marine Iron Works, Chicago.

A 500 h.p. National Feed Water Heater supplies the boiler with water through two 7½x5x6 Blake Duplex feed pumps, working against a boiler pressure of 200 lbs. The Polson surface condenser used consists of a shell 36 inches diameter and 10 feet long, with brass tube sheets and tubes, presenting a total cooling surface of 1,200 sq. ft. A 14x16x18x18 Blake combined circulating and air pump meets the requirements of this condenser.

The electric light equipment consists of a 15 k.w. Sturtevant turbo generator set, with the necessary switchboard and connections. This supplies 180 16-c.p. lights, as well as a 14 in. search light mounted on the operating cabin.

The steam piping throughout is of solid drawn steel with cast steel flanges shrunk on. All other small pipe connections are of the usual wrought iron type with malleable fittings. All valves up to 2 in. are of brass, while those above 2 in. are cast iron with brass seats.

Winch Machinery.

The winch machinery consists of five drums operated from a double 8x10 steam engine. Two of these drums are for swinging lines, two for spud lines, and one for raising and lowering the ladder. These are so arranged that any drum can be removed without disturbing the rest of the machinery. The spuds are lifted by two parts of rope, enabling them to be rapidly manipulated when stepping ahead. They are circular in sections and are held in steel casting guides with hinged caps to facilitate shipping and unshipping. The steel casting spud points are especially designed to penetrate stiff material.

A 500 h.p. Heine water tube boiler, carrying 200 lbs. pressure, supplies the necessary steam. The boiler is similar to that used in stationary practice, except that it is encased in steel and is supported by heavy channel girders and columns. There are two drums 42 in. diameter and 23 ft. 6 in. long, and 278 3½ in. tubes, 18 ft. long. The 7 ft. x 7 ft. grate is fed by a Murphy automatic stoker, and is supplied with forced draft from a Surtevant No. 7 multivane fan.

The controlling arrangement is well arranged, for all the winch drum brakes and clutches, and the various engine valves, are all controlled from the cabin in the bow of the dredge, by compressed air supplied from an 11 in. Westinghouse air compressor.

Similar dredges have excavated successfully cemented gravel, hard pan, shale, and boulders as large as would pass the pump passages, without injury to the machinery. The average output in fair digging has been 250,000 yards per month. Recently one of these machines excavated 24,600 yards in 20 hours, or at the rate of 1,230 yards per hour.

Fig. 3 shows the dredge being launched. The overhead crane shows one of the features made use of by the Polson Iron Works in the handling of their large jobs. This crane runs the length of their erection yard, so can take care of the work for several vessels while under erection. Large shear legs, not shown in view, handle the material after the vessel is launched.

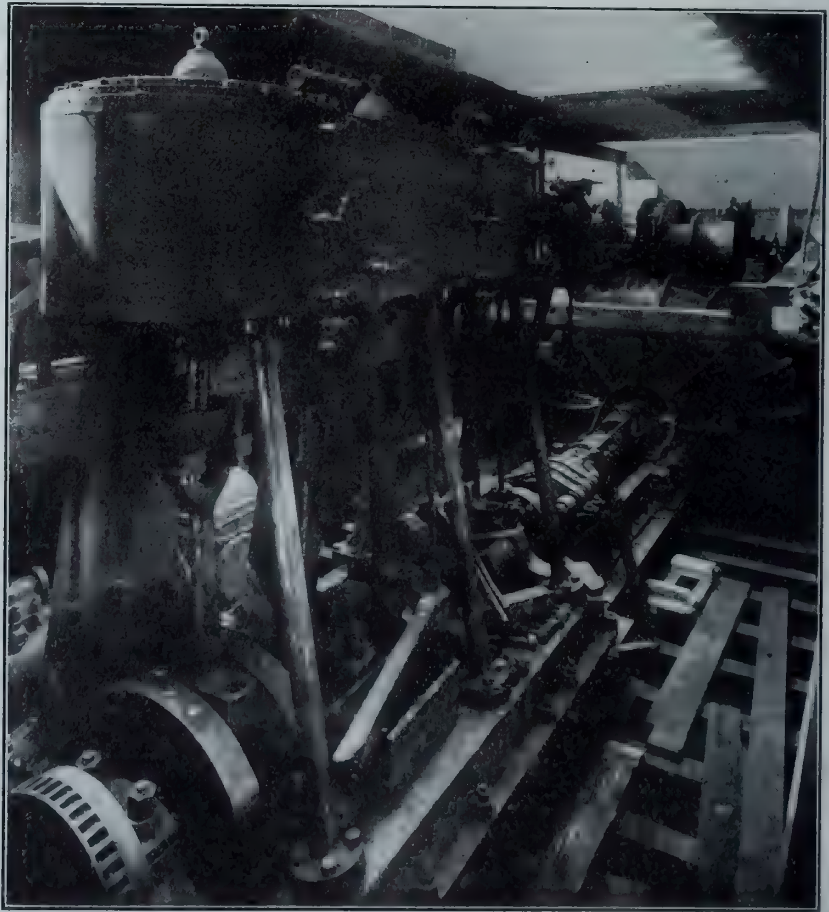


Fig. 2.—Machinery Equipment of the New Dredge Built at Polson Iron Works Toronto.

REFRIGERATION MADE SIMPLE

By W. G. Walters.

While the writer considers practical experience to be much superior to theory, the latter is quite essential, and I am trying to assimilate as much of it as possible. I shall endeavor to give a short discussion on the theory of refrigeration.

The act of compressing a gas generates heat, and, if that compressed gas be re-expanded, it practically absorbs the same quantity of heat that was originally generated, and will therefore cool to its initial temperature again. In this latter process, the gas simply absorbs the heat for its expansion from itself. If on the other hand, the compressed gas is cooled down before it is allowed to re-expand, it is very evident that it will not contain sufficient heat within itself to effect its own expansion, and will therefore have to extract that heat from its surroundings, and by so doing creates the sensation of cold.

The following example will make the above explanation simpler. Suppose we compress 1 lb. of air at 14.7 lbs. per sq. in., absolute (i.e. gauge pressure plus 14.7) and a temperature of 60 deg. F., to a pressure of 110 lbs. per sq. in. absolute. Then the resulting temperature will be 475 deg. F. and if we cool this air to 65 deg. F. we lower the temperature (475—65 equals) 410 deg. F. Now, as the specific heat of air is 0.238, the number of B.t.u.'s liberated will be (410x0.238 equals) 97.58. If, after this process, the air be re-expanded to its original absolute pressure, 14.7, it will have to absorb 97.58 B.t.u.'s to bring it back to the same temperature, and as the abstration of 170 B.t.u.'s from 1 lb. of water at 60 deg. F., will convert it into ice, it is evident that if the 1 lb. of compressed air above at 65 deg. F. be expanded in a suitable apparatus, surrounded by

$$\frac{97.58}{170} \text{ equals } 0.574$$

lbs. of water at 60 deg. F, that water will be converted into ice at 32 deg. F. These figures are not absolutely correct, but serve as an illustration of compressed air refrigeration.

The great advantage of ammonia over air as a refrigerating medium, lies almost entirely in its latent heat of vaporization. Suppose we compress 1 lb. of ammonia gas at 20 lbs. per sq. in. absolute pressure to 110 lbs. absolute, its temperature will be raised to 268.6 deg. F. Now, if we cool this compressed gas to 65 deg. F., we lower the temperature 203.6 deg. F., and the amount of heat attracted from the gas will be (203.6x.552 equals) 108.31 B.t.u.'s (.552 is the specific heat of ammonia). If, instead of cooling the compressed gas to 65 deg. F., we lower it still further to 60 deg. F., it will be converted into a liquid. As the latent heat of vaporization of liquid ammonia at 110 lbs. per sq. in. absolute pressure is 517.23 the following will now be the heat abstracted. In cooling the gas from 268.6 deg. F. to 60 deg. F., the heat generated is (208.6x.552 equals) 110.97 B.t.u.'s. The condensing process gives up the latent heat, or 517.23, making a total of (110.97 plus 517.23 equals) 628.2 B.t.u. These figures show the superiority of ammonia over air as a cooling medium, as it has a greater capacity.

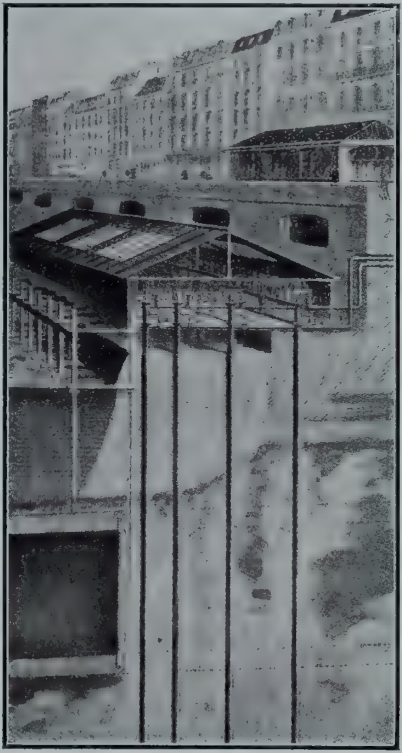
Various methods are in use for distributing the cold that is generated. The dry air process has been touched upon by the editor in a previous issue. There is also the brine system, where the brine has been cooled by the ammonia expanding in pipes immersed, or surrounded by brine, the latter carrying the cold where desired. Both these systems involve considerable machinery. In the brine system, fans, tank coils and centrifugal pumps are required which would require too much space here to detail. The indirect effect of the condensing water on the brine temperature necessitates considerable attention to valves, for any irregularities in the condensing water temperature will change the condenser pressure.

A little personal experience on the latter might be acceptable. The firm I was with had installed a new deep well pump. One morning after I had started this pump on the condenser, the agent who had sold the machine happened in, while I was in another part of the building, and thinking that the pump was running too fast he essayed to shut it down, with the result that it stopped, and all his efforts to restart it proved futile. During this interval the ammonia compressor was still working, and as no water was passing through the condenser, the ammonia gas would not distill, resulting in the pressure rising abnormally. Fortunately, I arrived on the scene in time to avert a catastrophe, as the pressure was then up to 350 lbs per sq. in.

FREEZING EARTH IN TUNNELING.

Freezing the soil under a river to make it solid enough for railway tubes to be built through it was the remarkable means utilized by the engineers of the Paris metropolitan railways in running the line under the Seine river. This section, 5,500 ft. long, passes under two arms of the river, under the city barracks, and under two working railway lines. It includes two stations which are situated below the level of the water. The junction of the caissons in the middle of the Seine, therefore, necessitated the use of a special process.

The ground which was frozen consisted of mud, sand, marl and limestone, and a large part of it was under the bed of the river. The freezing of such a mass of earth necessitated the installation of a powerful plant. A double pipe service carried the refrigerating liquid into a coil of boring pipes sunk into the earth, where it circulated and froze the soil adjoining the pipes by radiation, and then returned to the plant.



System of Soil Refrigeration.

Each tube had a radius of action of about 4 ft., and froze the soil by degrees, until it became compact and dry. On the conduits and pipes in the open air the coating of ice attained a considerable thickness, thus forming an excellent insulator for the tubing.

About three months after the beginning of the freezing a sudden inundation of the works caused the engineers much uneasiness, but it only proved the wonderful success of the system. A stream of water, passing under the upper part of the quay and across the foundations of the Orleans station, passed around the frozen mass, burst into the subterranean part which was being pierced, and completely filled it. A cofferdam, about 200 ft. long, had to be constructed along the whole length of quay to cut off the water. During the four days required in draining the underground it was feared that the water would have thawed the frozen mass, but it was discovered that the water had frozen into a solid wall of ice.—Popular Mechanics.

PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

HIGH AND LOW WATER ALARM.

By James E. Noble.

There are a number of high and low water alarms for steam boilers so simple in construction that any engineer who is handy with tools can make them. Several which I designed and experimented with are here described and illustrated. They are what are known to some folks as "freak" alarms. Nevertheless if they are carefully made and used with ordinary care they will prove as reliable as many an expensive alarm.

The pipe which extends downwards inside the boiler is absolutely necessary for I found while experimenting with them that the rods attached to the floats soon became bent, thus puting the alarm out of operation, unless the pipe was there to act as a guide and support.

In Fig. 1 A is a heavy copper float, B is a piece of pipe screwed into the shell of the boiler. A long thread on the upper end extends through the shell. A check valve D is screwed onto this long thread; C is a ⅜ inch brass rod. The rod C is attached to the disk of the small upright check valve, the valve being upside down.

In this alarm there is no packing of any kind. The area at L is so little over the diameter of the rod C that it does not materially affect the operation of the device. A valve and whistle can be added as shown.

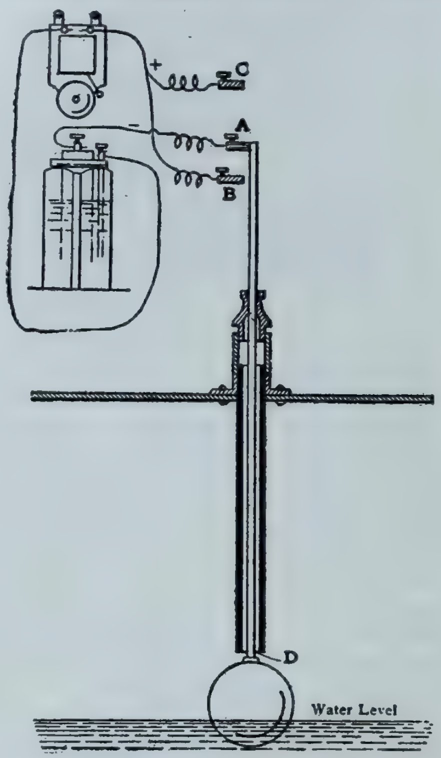


Fig. 3.

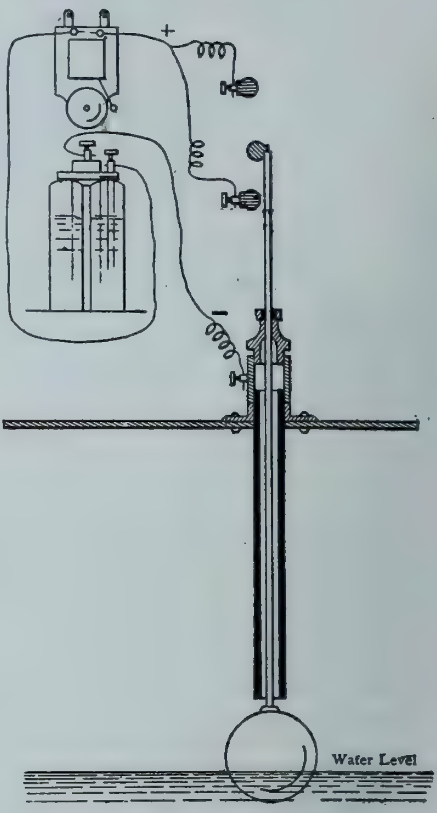


Fig. 4.

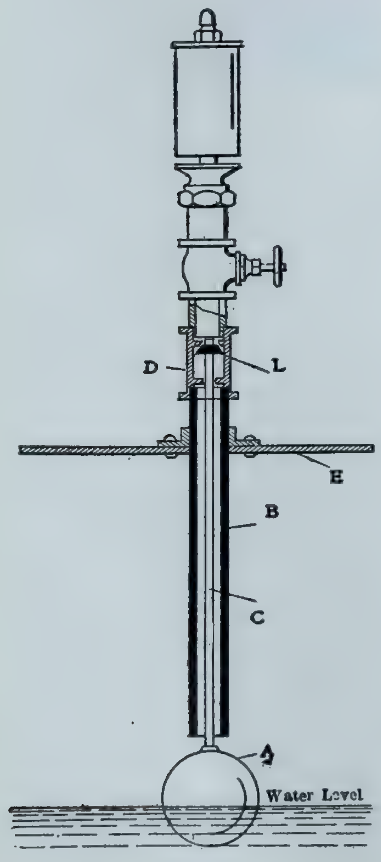


Fig. 1.

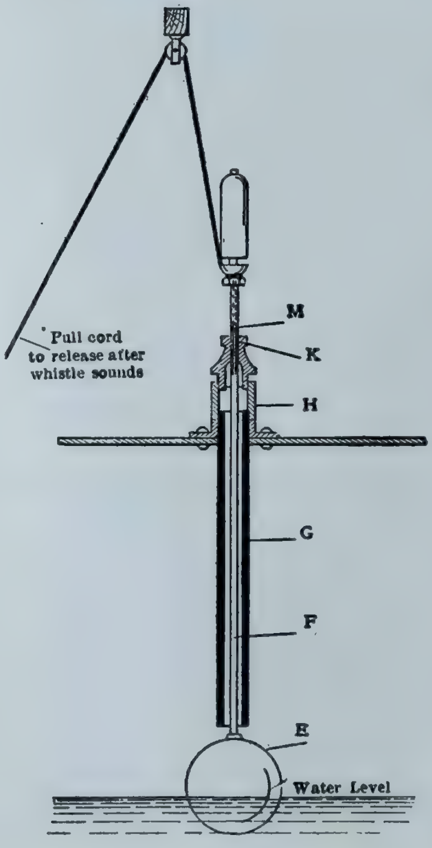


Fig. 2.

Fig. 2 has a guide pipe G, but instead of a solid rod being attached to the float (as in Fig. 1) a hollow brass tube is used with a whistle on the upper end. A ¼-inch hole is drilled through the tube at M, metallic packing is used in the packing box. When the water gets below its proper level the float pulls the tube down with it and the hole M is brought into the steam space which will cause the whistle to sound the alarm. The whistle will continue to blow until the water is raised in the boiler, or it can be stoped by raising it with the arrangement of cord and pulley as shown. Of course the operator should be careful and not forget to again lower it when the water is again at its proper level.

For the boys who prefer an electric alarm the bell circuit Fig. 3 is shown. This alarm will sound for both high and low water. D is a ⅜ brass rod working inside a ½ inch iron pipe with a ¼-inch valve packing box on the top of the ½-inch pipe. The piece A is attached to one wire of an electric bell outfit and B and C to the other wire as shown. The bell can be carried to the office or any part of the building desired. Fig. 4 is practically the same device, the only difference being in the wire connections.

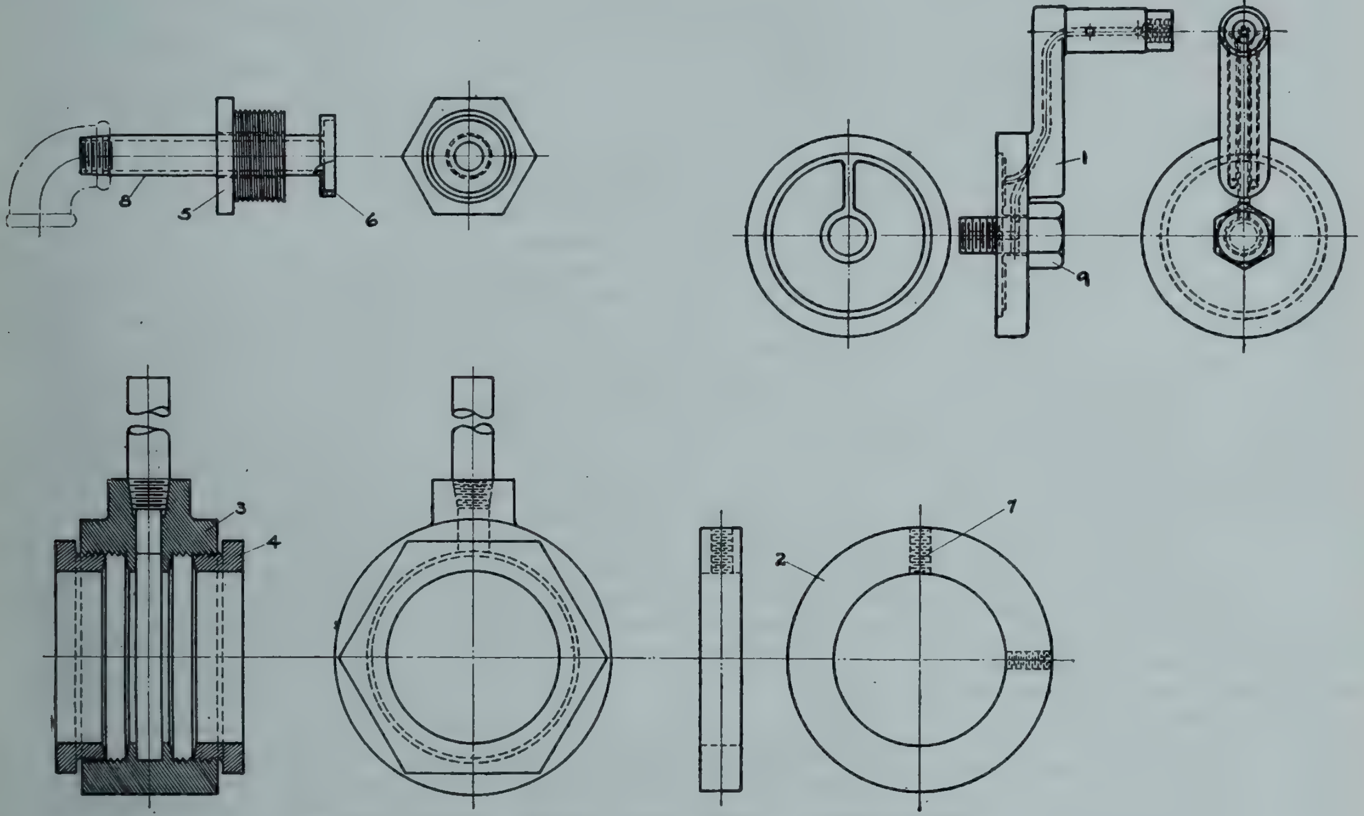
CRANK PIN OILER.

By K. Campbell.

The accompanying illustrations show a crank pin oiler with provision being made for water cooling of crank. It is a sure cure for hot cranks and has been tried out successfully. Recently saw gates were made by John Inglis, Toronto, for McLachlin Bros., Arnprior, and these were equipped with these crank pin oilers.

The oil is fed to the centre hole, a packing nut being provided. The two outer tubes are for the water supply, inward and outward flow. The water provides cool bearings at all times.

In the illustration 1 is a brass crank arm, 2 is a brass collar, 3 a brass sleeve, 4 a brass nut, 5 a brass nut, 6 a brass ring, 7 wrought iron set screw, 8 wrought iron oil pipes and 9 tap bolts.



Crank Pin Oiler Cooled by Water Flowing Around the Crank.

EXPERIENCES IN BOILER PRACTICE.

By J. A. S., Newcastle.

Those engineers who appear to regard the operation of boiler plant as simply a technical method of throwing on coal, are probably laying up to themselves more trouble than they know of, owing to lack of proper supervision of their plant, and the following notes are given in order to show that even with the best designs of boiler and auxiliary gear trouble is likely to occur which unless properly met will result in disaster. For example, in a case where a boiler of the Lancashire type had a corrugated furnace tube, this tube managed to develop a crack. This may possibly have been due to allowing the tubes to cool too rapidly when fires were drawn. The resultant seven inch crack was, however, a very serious problem, more especially as the boiler was urgently required for service. The way in which the trouble was overcome and the crack prevented from expanding, was to screw in interlocking plugs the full length of the crack. These screws were ⅝ inch diameter, and closed up on both sides. This repair which at first was only considered temporary, worked so well that it carried the boiler through for some considerable period.

In land practice one of the latest and most valuable form of grates for boiler purposes is composed of a series of links arranged side by side to form a broad belt of metal which passes over a drum at either end of the furnace and is revolved slowly carrying forward with it the fuel which becomes coked, the clinker and ash finally dropping over at the back of the grate into an ash pit. This arrangement is so thoroughly automatic that sometimes engineers attempt to impose upon it too much, responsibility without adequate attention and the natural result is that the plant is subjected to adverse criticism which it does not deserve. One instance may be quoted as an example of the way in which a little oversight will spoil the working of a good gear of this class. In one of the latest types of such stokers a chain is used in order to transmit power from the driving shaft above and in front of the boiler to the stoker gear. There is a bracket fixed on the side of a coal hopper immediately in front of the boiler which holds two small adjustable sprocket wheels which are used in order to take up any slack that there may be on the drive. They are also valuable in keeping the chain out of the way. This bracket in one instance was fixed to the hopper with two studs and in this case one of the nuts on the studs worked loose and as this was not observed in time a cross strain was allowed to come on to the casting which broke and put the gear temporarily out of commission. In order to provide against any further chance of trouble due to non-observation in this direction lock nuts were put on the studs which held the new bracket.

In another case where a similar type of revolving grate stoker was used, the grate was driven by means of a ratchet and pawl motion, operated by means of an eccentric on the driving shaft and the connecting rod. This rod in one instance, had been taken off while the grate was being overhauled and the lock nut which rested against the pawl on the bottom end of the rod, had been slackened off and had not been replaced correctly. This had the effect of slightly lengthening the rod and the extra length caused the eccentric strap to break.

Yet another instance may be given of the way trouble may be caused on this type of grate by incomplete observation. It was found that a grate of this type owing to being too hard pressed gave way, and three wheels on the front drum were broken before the cause of the trouble was discovered. The first wheel broke on full load and another driving wheel was immediately put on. The grate was then tried by hand and as it worked freely the mechanical drive was put on. The grate then ran for twenty minutes when the second wheel cracked across the boss. The boiler was then fired by hand until it could be spared as it was then thought that one of the dumping bars on the grate was catching. When the boiler had cooled down sufficiently, all the dumping bars were lifted and a new wheel was put on. The grate was then worked by hand for some time and then it was put on the power drive. Almost immediately the third wheel broke. Up to this point the grate had been examined in place, but it was necessary to withdraw the carriage before the true cause of the breakdown could be discovered. It was then found, however, that one of the toothed wheels forming the drum at the back end of the grate had broken owing probably to the boiler being forced and three teeth had been broken off this wheel leaving only about three-quarters of it capable of doing its usual work. This, when the grate was working at its normal speed, threw a heavy cross strain on the whole grate holding it up and causing the driving gear wheels to fracture as described above. In order to get the boiler to work again the faulty tooth wheel at the back was replaced and the second gear wheel at the front which had cracked across the boss, but not through the rim was repaired by shrinking two wrought iron rings round the boss. This avoided the delay which would have taken place if a new wheel had been ordered, and the repair proved satisfactory.

CYLINDER OIL CONSUMPTION IN MARINE ENGINES.

By J. Crawford Smith.

Cylinder oil is one of the dearest oils manufactured for lubricating purposes, costing about 54 cents per gallon; and consequently it should be used economically.

With surface condensers it is sparingly used and a feed filter installed to prevent any reaching the boilers. This danger is obviated on the lakes by discharging the hotwell water overboard and feeding from the circulating discharge, which is a wasteful method.

On our salt water steamers, where the surface condenser must of necessity be used, very little oil is necessary to keep the valves and pistons operating smoothly. No oil is fed directly to the cylinders and casings except by a steam lubricator, which is only used as a stand-by and which I only saw once used in four years. No other provision for oiling the cylinders is provided, nor does any appear to be required. All cylinder oil that is consumed is used for swabbing piston and valve rods.

A lake steam boat of even half the I. H.P. of the average ocean freighter, consumes a great deal more cylinder oil. Every casing and cylinder is fitted with a hand pump; the geared oil pump is sending oil into the cylinders all the time; every pump in the engine room has its little oil pump; and every dynamo a lubricator.

It would be interesting to ascertain how small a quantity of cylinder oil some engineers could run their engines with if they tried.

The fear, however, of a valve siezing, or a piston scoring its cylinder results in many engineers flooding their engines with cylinder oil, wasting oil and choking their pump valves with grease.

The jet condenser is commonly used on the lake steamers, though many are fitted with surface condensers and even in these the air pump discharges the hotwell feed overboard. Many firms insist on this arrangement, either as a precaution against furnace crowns coming down or from a want of faith in the engineer.

The short runs, the continual clicking in canals and rivers and so much astern work of the lake steamer compared to the long runs of the ocean boat, may partly account for the use of more oil, but that can not account for it all.

The views and experience of your readers would be interesting on this subject.

COMBINED INDICATOR DIAGRAM.

By J. E. B. Phelps.

Herewith is a set of indicator diagrams taken from a cross compound, condensing Corliss pumping engine 20 inches x 38 inches x 30 inches, and also the combined diagram for publication.

For the h.p. cylinder by using a Willis Planimeter, I find the m.e.p. to be 24.5 lbs. and the 1 h. p.=

$$\frac{\text{PLAN}}{33{,}000} = \frac{24.5\times5\times314.1\times32}{33{,}000} = 37.31 \text{ 1 h. p.}$$

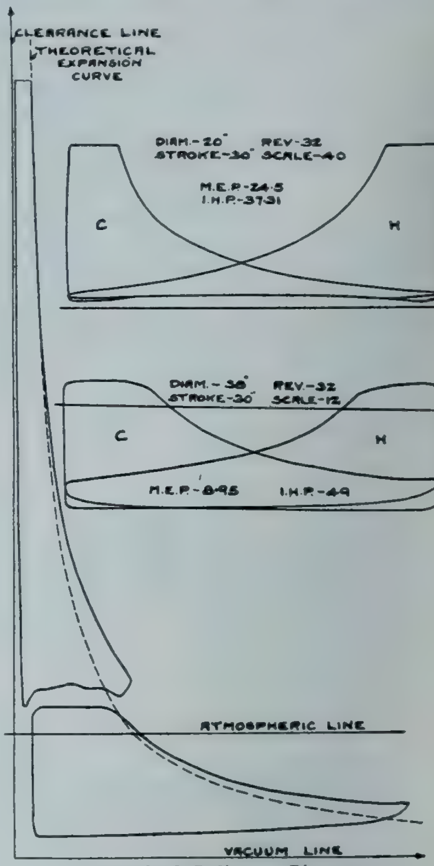
The m. e. p. of the l. p. cylinder 8.95 lbs. and 1 h. p.=

$$\frac{8.95\times5\times1134.1\times32}{33{,}000} = 49 \text{ 1 h.p.}$$

showing an unbalanced load between the two cylinders of 49—37.31=11.69 1 h. p.

The l.p. cylinder of this engine is steam-jacketed, a pressure of 20 lbs. being maintained.

Text-books on engineering, all inform us that all of that part or parts of the diagram outside of the theroetical expansion curve is a loss, as well as that space between the diagram and between the back pressure line of the l.p. and vacuum line.



Combined Indicator Diagram.

I would like the readers of The Power House to express their opinion as to what changes are necessary in the valve setting to improve the economy of the engine.

James C. Kennedy, C.E., has recently opened an office in the Flack block, for private practice as civil and hydraulic engineer. The work accomplished by Mr. Kennedy, at Stave Falls, where for three years and a half he was the engineer-in-charge for the Stave Lake Power Co. and for the Western Canada Power Co., has shown him to be highly experienced and of great ability in his profession.

A. A. Dion, general superintendent of the Ottawa Electric Co. has been notified of his election as a member of the British Institution of Electrical Engineers. This organization is the premier electrical society of the empire, and is ranked the highest in the world. Mr. Dion's work in electrical matters has also been recognized by both the American and Canadian engineering societies in the past.

Correspondence

Discussion on Previous Articles
Remuneration for Useful Ideas

TROUBLE WITH WATER SUPPLY.

Boiled down this question amounts to the following—will a single acting pump 3 inch diameter by 16 inch stroke, 35 revs. per min., driven by a 3 horse-power motor, lift water say 25 feet, and force the same up 100 feet in the tank?

Let us consider the horse-power requisite for this work.

dia.=3inches. stroke 16 inches.
area=7 sq. ins. revs. 35.

therefore $\dfrac{7\times16\times35}{277} = 14$ gals. per min.

Horse-power required=total lift × weight ÷ 33,000

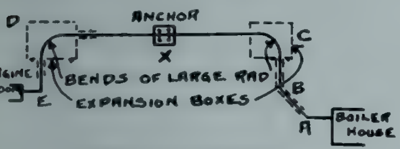
that is $\dfrac{125\times14\times10}{33{,}000} = .53$ h.p.

allowing 40 per cent. for friction, this amounts to ¾ h.p., which shows that the pump is of ample power, and will deliver 14 gals. per min.—F. J. Binckes.

STEAM PIPE DIFFICULTY.

The cause of nearly all the trouble with this pipe line can be traced to the fact that it hasn't been anchored at a certain point, and its expansive powers thus kept under control.

I would place a concrete foundation at x, and fix the pipe securely to it. Also, the sharp bends at D and E might be replaced by one of large radius.



Steam Pipe Difficulty.

This done, and proper attention given to draining, all trouble should cease.

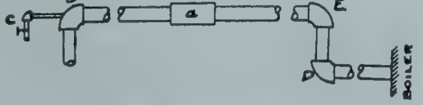
As to placing pipe in tile, I should certainly do so, if the pipe is over 1½ inches in diameter, but care need be taken to see that is is properly drained. —F. J. Binckes.

In the May issue of the Power House, page 58, Richard Brock describes and gives a sketch of some steam pipes and difficulties he is having, due to the unequal expansion and contraction of same. I should suggest that he uncover the pipe, and place iron rollers underneath for the pipe to rest on, so that it would be free to move, and box it in both sides and top. I think if an expansion joint of a U-shape were placed in the 625-foot pipe, it would take care of the expansion there, and save the joints C and D. If the 625-foot pipe C D persists in moving in a westerly direction, the end of the pipe could be blocked to prevent it moving west, whilst at the same time, allowing pipe D, E, to expand in a northerly direction. It would improve matters if as you say the abrupt turns were taken out at C and D.—J. C. Tweedale.

In the May issue, there is a request from Richard Brock for a solution of his piping troubles. It can be solved in the following manner: Put the pipe in a box, so that it is free to expand longtitudinally. The pipe should also be cut half way between C and D, and a common expansion joint inserted. If this joint is packed with any form of good packing, no trouble will be experienced. Also build a box of some sort around the expansion joint, to allow for opening readily for repairs such as tightening up the gland nuts.

Burying a pipe for transmitting steam, under two and a half feet of earth is very bad practice, and I should recommend that it be discontinued in future. —Jno. Woodriff.

Two years ago I went to a large sawmill where they had much the same difficulty as Mr. Brock describes in your valuable paper. On my arrival the manager explained matters and asked me to fix it up so that there would be no breaks or loss of time. I did so in the following manner. I brought steam pipe straight from boiler as far as I could, then elbow B straight pipe down to elbow E, divided long pipe and put in expansion joint (a) and drilled a ¾ inch hole in elbow B in which I stuck a drain pipe with valve C. When turning on steam leave valve C open and I am sure you will find it hold good as mine did. Shavings, D. C.



Steam Pipe Difficulty.

With reference to steam piping difficulties in the May number, the expansion from A to B would be about 3-8-in.; B to C, 1 1-8-in.; C to D, 13 inches, and D to E, 5-8-in. These lengths are not figured out exactly, but serve their purpose. If the pipe is properly installed there will be be no trouble from creeping pipe or broken fittings. Your correspondent states that ample provision is made for expansion and contraction, but I am of the opinion that he is mistaken. The fact that point D is two feet lower than C, should make no material difference. It might be that allowance is made for expansion from C to D and B to C neglected, this would explain why trouble was being had at point C. Also water hammer might have some effect, as no mention is made about bleeders or drains. One thing is certain, that, with the system installed as shown, no trouble should be experienced in erecting it to obviate all trouble from broken fittings or creeping. I have installed steam lines from 100 to 2,700 feet long and never had the trouble mentioned. Last summer I run a steam main under ground for a distance of 300 feet, and used no expansion joints, outside of a right angle or 90-degree turn at each end. The main was covered with sectional asbestos pipe covering, one inch thick, and run through common sewer pipe (tile pipe), with cement joints at the hubbs. I believe that it is a great mistake to lay a steam main in the manner described by your correspondent. If there is only one or two coverings of the asbestos paper it is about as bad as contact with the ground, and if the ground in which the pipe is buried is exposed to the weather it is certainly very imperfect, for when it rains the moisture will penetrate to the main and a lot of steam will be used in drying out the surrounding ground. The rain will also have a tendency to pack the earth around the pipe and thus prevent free expansion or contraction. Your correspondent suggests using tile pipe from C to D and wood boxes at the 30 and 58-foot runs at the ends; but, if the whole thing is under ground I would advise using tile exclusively, amply large to allow for expansion. Another thing in which your correspondent is mistaken, is, that the contraction is less than expansion. In a pipe the linear contraction caused by cooling would be exactly the same length as the expansion caused by the steam heat.—James E. Noble.

In answer to you query re Steam Pipe Difficulties, in the May issue, I may say that the whole trouble lies in the 625-foot of steam pipe. I presume that the pipe is of wrought iron, which has an expansion of .0146, i.e. c=.0146. Assuming that the working pressure on the boiler is 100 lbs. per square inch, and the temperature of the pipe, say 80 degrees F., when the steam is off. The temperature of steam at 100 lbs. pressure is 336 degrees F.

If T=temperature of steam.
T_2=temperature of pipe when steam is shut off, and
L=length of pipe, then

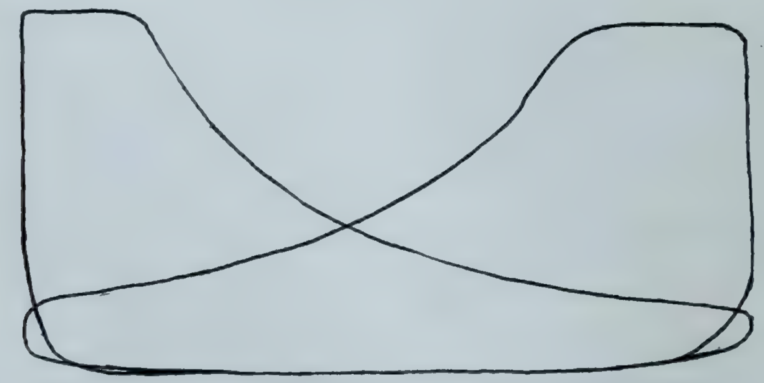
$$C \times \left(\frac{T_1 - T_2}{180}\right) \times L$$

$$= .0146 \times \left(\frac{336\text{-}80}{180}\right) \times 625.$$

$$= .0146 \times 1.42 \times 625 = 12.95 \text{ inches.}$$

From the amount of the elongation, I would suggest that you put a common stuffing-box and gland between C and D, with the shorter lengths B, C, D and E, an ordinary U bend, put in the pipe will be sufficient.—A. T. Roffey.

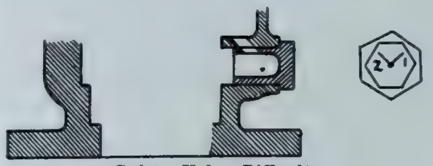
With reference to the question of steam piping in the May issue, if joints C and D have sufficient give you could securly fasten the pipe midway between C and D, and that would prevent the creeping. A small cement pier with clamps and stays would no doubt hold it securely; otherwise it could be remedied by securely fastening it at C and D and putting an expansion joint mid-way. This would be the best plan and as the writer suggested it should all be placed in a box and supported on rollers where possible so that the pipe can expand easily and not buckle. Care should be taken when fastening at C and D to leave room for expansion of the 30 and 50 foot lengths.—A. F. Moray.



Does this Show any Leaks?—Card Full Size.

SAFETY VALVE DIFFICULTY.

In the May issue of The Power House E. V. Morrel wants to know what makes his safety valve blow back. Now almost all makes of spring pop valve have a plug at the back by which the blow back can be regulated. There is generally two marks on the hexagon head of the plug for a guide in setting it as at 1 and 2.—L. Rhodes.



Safety Valve Difficulty.

The cause of difficulty is the lack of enough steam escaping through the small holes in the seat of valve. In the B.C. Standard pop valves there is a plug to regulate the steam escape. In the case before us, this should be opened to allow more steam to escape—in fact you can regulate it so as blow 2, 3, 4, or 5 lbs. as the engineer desires. In other valves there is a set screw holding the rim in position which the engineer can undo and then set the holes to his pleasure. Shavings, B.C.

In reply to the Safety Valve difficulty, I must give my opinion in the following manner:

The fault lies with the safety valve spring, which I think has lost its rapid-acting elasticity. The spring remains expansive till the maximum pressure (130 lbs.) is reached, then it compresses and the valve begins to blow, and on account of its inflexibility due to the deterioration of its co-efficiency it remains compressed till 100 lbs. is reached, and then it expands and forces the valves down on their seat, to repeat the process when 130 lbs. pressure is again reached. —Jos. Arthur.

KEEPING BOILERS CLEAN.

Since writing on Boiler Feed-water Problems, we have installed two more cleaners in another plant. The first boiler was opened after running three weeks, and contained about two shovelfuls of scale. In this boiler we used sal soda and Irish moss.

In the other boiler we used tri sodium phosphate. After running it for four weeks, carrying the whole load, as the first one had done, the boiler was opened. There was no more scale and mud loose in the boiler than there is on this paper, and the quantity attached to the tubes and sheets had been greatly reduced. At the previous cleaning, after running for three weeks without the cleaner we had taken about three-quarters of a barrow load of mud and scale. These two boilers were very dirty to start with. We also learned that tri sodium phosphate is a better scale solvent than sal soda, in our case, at any rate.—R. McLaren.

ASBESTOS PACKING.

In reply to question re asbestos packed valve cock in May issue, I am using them for blow-offs and use asbestos only. I have found that it must be all pulled apart like wool and driven in very hard with a tool made to loosely fit the grooves. It must be kept dry and care taken to have the grooves fitted at the bottom. The plug must be secured with a strap, and a couple of bolts and left projecting out about ¼-inch so that it can be drawn very tight when finished. I find that when packed this way they work much more easily than when they are packed at the factory where the asbestos is vulcanized. I have had them run as long as six months without re-packing. That is as good as when packed at the factory.—A. F. Moray.

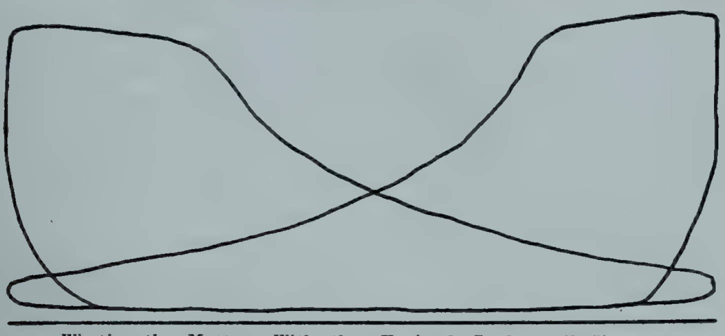
POWER OF TRACTION ENGINES.

Would you let me know through your paper how to determine the tractive power of different types of tractive engines in Canada in both the east and west.

As a suggestion, would you publish a special on gears and how to determine the proper sizes to use at any given power and speed. This would be well received by engineers generally.—John J. Anderson.

WHAT'S THE MATTER WITH ENGINE?

The accompanying indicator card is from a 11¼ x 30 Brown Automatic Cut-off Engine. The steam pressure is 93; R.p.m. 99; and scale 50.



What's the Matter With the Engine ?—Card Full Size.

It was taken by a first-class engineer, who claims that it is all right. Before the valves where shifted to their present position, no trouble was experienced in keeping up steam, but since, it has been impossible to do so.—George Polson.

SECOND USE OF OIL.

I would like through the columns of your valuable paper to gain some information regarding the second use of cylinder oil.

In my engine, which is a triple expansion Corliss pump condensing, supplied at 200 lbs. pressure, the hot well pump saves all condensed water from engine for refeeding to boiler. We have placed a separator, which separates all oil from it at discharge of hot well pump.

Now the oil comes through in apparent good form, not gummed or any heavier, and it appears to be good enough to use again. Would it be good enough to pass through high temperature steam again?

Please give all particulars regarding temperature it would stand upon second use. We always use first class high fire test oil, never less than 620. Could it be used more than twice?

A great saving of oil would result could we but always use this oil again. Should more of it be used than other oil?—Ernest Ivie.

HYDRAULIC QUESTION.

Replying to the hydraulic question asked by McG., in the April issue, page 53; the following formula can be used for calculating the flow of water through a short pipe with opening same size as the pipe.

$$Gs = .09445 \times d^2 \times \frac{h \times d}{\sqrt{f \times l + 1\text{-}8d}};$$

Gs=Gallons per second.
h=head of water in feet, (the head is found by multiplying the pressure per square inch by 2.31);
d=diameter of pipe in inches;
l=length of pipe in feet.
f=coefficient of friction (in this case, f=.025), .09445 is a constant.

Substituting the figures for the letters in the formula, we have,

$$Gs = .09445 \times 2^2 \times \frac{80 \times 2.31 \times 2}{\sqrt{.025 \times 2 + 1\text{-}8 \times 2}} =$$

$$.09445 \times 4 \times \sqrt{\frac{369.6}{.3}} = .3778 \times \sqrt{1232} =$$

$35 \times .3778 = 13$ gallons per second approximately. By multiplying by 60 the gallons of water per minute can be found and is $60 \times 13 = 780$ gallons.—J. C. Tweedale.

In The Power House for April, McG. asks, "What would be the discharge of water in gallons per minute from a 2 inch pipe, 2 feet long at 80-lb. pressure? The discharge can be found by the formula $Da = .815\, A\sqrt{2gh}$ the head in this case $= 80 \times 2.304 = 184.32$ ft. then

$$Da = \frac{.815 \times 3.1416}{144} \sqrt{2 \times 32.16 \times 184.32} \times 60 = 116.15$$

cubic feet per min. Multiplying this by 7.5, the number of U. S. gallons in a cubic foot we have 870⅛ gallons per minute.

In the formula Da = quantity discharged in cubic feet per second.
g= Acceleration of gravity.
h= head in feet.—L. Rhodes.

Four years ago I put in a syphon 9,000 feet long, 700 feet was laid on a level out into a lake. The pipe was divided into 4, 3½, 3, 2½ and 2 inches, with a drop of 196 feet, the guage showed a fraction of 85 pounds with the valve on the end of the 2 inch pipe closed. For the testing of the same, the 2 inch pipe discharged 93 imperial gallons.

The test was made to decide the quantity. All the ends of the pipe were reamed and expanded in the couplings to reduce the friction as much as possible. The raise was 12 feet above the lake. I have before me tables that are generally used and for ordinary purposes are not very far out. Take the 2 inches asked for and the following is the table:

Pounds per sq. in.	feet.	Velocity of discharge in feet per second.
80	184.72	2 in. pipe, 1,068 gallons
80	184.72	3 in. pipe, 2,403 gallons
80	184.72	4 in. pipe 4,274 gallons
80	184.72	1½ in. pipe, 601 gallons
80	184.72	1 in. pipe, 267 gallons
80	184.72	¾ in. pipe, 150 gallons
80	184.72	½ in. pipe, 66.8 gals.

American gallons.

If your correspondent is using 2 in. pipe, is it wrought or cast iron? is the burr removed from cutting and screwing? All these points must be taken in. A 2 inch pipe cut off with a pipe cutter is bad, but if cut off in a lathe will not fill more than a 1½ inch pipe. Not wishing to occupy more of your valuable space.—Experience.

LEAKY VALVES.

I would like to know if the card enclosed shows any leaks through the valves. The card is taken from a 16x30 Wheelock, running 90 r.p.m., at 25 inches vacuum and 85 lbs. steam pressure, with a No. 40 spring. Also, what is the h.p?—A. F. Moray.

BOILER DESIGN.

In the May issue of The Power House J. A. McGillwray says that the formula is not correct for finding the area of the segment of a circle as per the March issue.

The March issue has it

$$A = \frac{4h^2}{3}\sqrt{\frac{2R}{h}} - .608$$

What I understand by Mr. McGillvray is

$$\frac{4h^2}{3}\,\frac{D}{\sqrt{h}} - .608,$$

and I take it that he means four times the square of the height over three times the diameter over the square root of the height minus .608. The first is the way.

Let h=16, D=50, then $A = \frac{4 \times 16^2}{3}\sqrt{\frac{50}{16}} - .608 = 341.33\sqrt{3.125} - .608 = 541.52$ sq. in. L. Rhodes.

STEAM PRESSURE QUESTION.

Replying to some questions asked by Geo. Miller in the April issue, page 53. There will be a fall in pressure between the boilers and engine. The loss of pressure will depend on the insulation of the steam pipe and the amount of friction inside and also the length of the pipe.

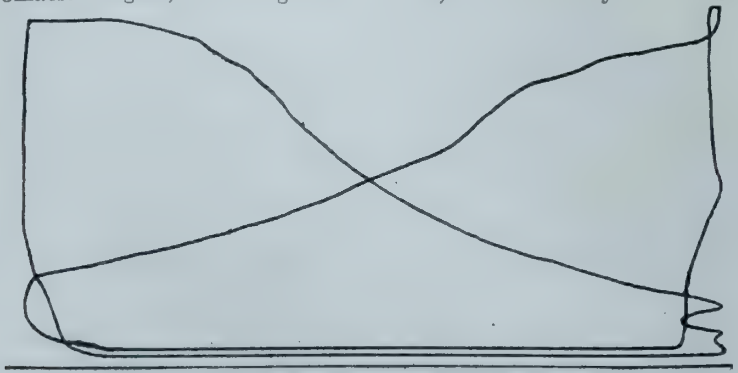
Only good quality cylinder oil should be used in a steam cylinder, whether on an engine or a pump. Mineral oils carbonize and burn up, due to the heat of the steam, and do not lubricate. Fine powdered graphite mixed with cylinder oil, injected in small quantities by means of a hand pump will do good. About 10 parts of oil, to one part graphite is a good proportion. I might say, graphite should not be fed into a hydrostatic (sight feed) lubricator, as it will choke up, due to the graphite settling in the passages of the lubricator.

The question of heating at different pressures, and the economy of a certain pressure over another pressure, cannot always be settled off hand. Steam at a pressure of 85 lbs. above atmosphere has a temperature of 327 degrees F., and contains 1181 B.tu,'s per lbs. of steam. At 40 lbs. above atmosphere the temperature is 288 degrees F., and B.t.u.'s is 1169 per lb. of steam. By using the higher pressure you have a gain of 39 degrees F., at an expenditure of 12 B.t.u.'s per lbs. of steam. Theoretically speaking, the higher pressure would be the cheapest and best, but in practice it does not always work out. If you have any quantity of exhaust steam, it would be far cheaper to use it, and if not sufficient, live steam could be admitted to the heating system through a reducing valve at about 5 lbs. pressure. If the heating system is very large, a vacuum pump may be needed to draw back the condensation, besides getting a great deal more heat from your exhaust steam. There is no doubt about exhaust steam being cheapest for heating, as it costs practically nothing, for the steam has already done the work for which it was generated, and would otherwise be wasted. To my mind, it would pay to investigate the vacuum system of heating, especially where there is a large amount of heating.—John C. Tweedale.

SETTING VALVES.

This diagram is from an 18x20 Buckeye automatic engine, running 135 r.p.m. with 100 pounds steam, non-condensing.

How should the valve be set? I am sending this card for the benefit of beginners, and any pointers on it will be thankfully received.—J. B. G.



Card of Buckeye Automatic—Card Full Size.

LEAD WOOL.

Will you please give me any information as to what lead wool is and to what uses it can be put?—J. Johnson.

Lead wool or shredded lead has been used for the purpose of calking joints on both water and gas mains. It is stated that it makes a very flexible joint and one which holds well. It can be used on very wet work or even under water. It has been used with success by various gas companies and the resulting loss of gas is stated to be less than with the usual poured joints. —Editor.

BOILER FEED.

Supposing I have 4,000 pounds of water to feed to a boiler in a given time, will the water last longer if the pressure is 100 pounds instead of 60 pounds?—R.

STEAM DEVELOPMENT.

Mr. R. H. Thurston, of Cornell University, states in an article written by him for the Encyclopedia Americanna that in the year 120 B.C., there was found at Alexandria a manuscript which proved to be a Hero's "Pneumatica," and although the power of steam in connection with some sort of an engine has undoubtedly been known to mankind since the prehistoric period, this, however, is the first record of the steam engine and describes what is in all probability, the most simple steam turbine possible of construction.

There is however, very little record of anything like a steam engine of to-day until 1705 when there was patented by Thomas Newcomen and his partner, John Calley, the first properly so-called steam engine. This consisted of a steam cylinder and piston actuating a beam above, from which was pendant the pump rod operating the pumps in the shaft of a mine; it was always used as a steam pumping engine, but was later improved by the addition of various valuable devices which gave James Watt his fame and fortune. This type engine became known later as the Cornish engine, and after Newcomen's death, was further improved in details by Desaguliers and by Smeaton. In 1718, the first automatic valve-motion was carefully designed by Henry Beighton. This, with Watt's invention of the separate condenser, the steam jacket, double-acting engines, the governor, etc., step by step, produced the engine that is the real basis of those we have in use at the present time.

From the small engines of the early part of the 19th Century, to those of the present time, is a change a little hard to appreciate, for it is estimated that the work of the world is performed by steam engines mainly, probably amounting to 150,000,000 h.p. and equivalent to the working power of several times the population of the globe, if employed in manual labor.

The wonderful growth of the steam engine is further evidenced by a letter recently received from the Penberthy Injector Company of Detroit, stating that on March 29, 1910, injector number six hundred thousand (600,000) was stamped and recorded ready for delivery. When we stop to consider that the above company, the largest manufacturers of injectors in the world, has since 1887 made 600,000 of their automatic injectors, we obtain some idea of the large h.p. of the boilers which must be in operation at the present time, for it has been carefully estimated that 600,000 (size 2½") GG Penberthy Injectors would force into a boiler against 90 to 100 lbs. pressure over 1-3 of the amount of water that is constantly going over Niagara Falls, which is approximately 125,000,000 to 150,000,000 gallons per minute. This when transformed to steam at 70 lbs. pressure is sufficient to develop power amounting to approximately 700,748,661 horse-power, or very near five times the estimated horse power of the world's steam machinery.

Should the growth of steam power increase in the next hundred years as it has in the past, we will have as a result a combined horse power capable of performing work the magnitude of which would be so great as to be almost inconceivable to the average person of today. The likelihood of the development in steam power during the next century, however, is not so much in a larger number of engines and boilers, although this, is, through the natural growth of the universe, inevitable to a certain extent, but rather in an increased efficiency in those power plants which are to replace those that, because of age and wear are constantly being discarded.

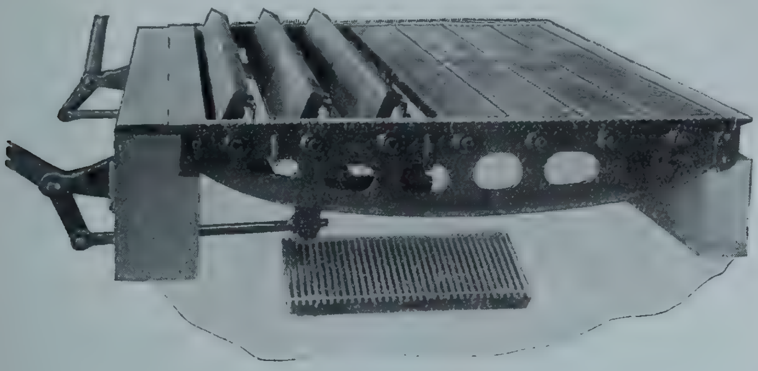
NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

IMPROVED CAPITAL GRATE.

The accompanying illustration shows the improved Capital grate manufactured by the Butterworth Foundry, Ottawa. The air spaces have been enlarged to allow a greater supply of air to ensure complete combustion of the fuel. There are also several other improvements.

The sections have been divided into two parts so that if one burns out, for any reason, only a small section of grate is required to renew it. The bearings on which the trunions work are removed from the fire over three inches, lessening the danger of these being clinkered. The sections can be removed and replaced by new ones in a few minutes.



New Grate of Butterworth Foundry, Ottawa.

AUTOMATIC WATER-WEIGHING APPARATUS.

Every engineer realizes the difficulty of securing accurate measurements of boiler feed water. While, in many cases, meters are sufficiently accurate for all practical purposes and fairly dependable in service, they do not give the refinement in measuring which is necessary in accurate work, and the rate of flow, temperature of the water and the amount of foreign matter carried therein all affect their accuracy.

A device, which is claimed to overcome these difficulties and to give measurements varying not more than one-half of 1 per cent. from the absolute, has been brought out by the Kennicott Water Softener Co., Chicago Heights, Ill. The apparatus, which is known as the Kennicott water weigher, has no valves, and dirt, scale, sediment, etc., do not affect its accuracy. Briefly, it consists of a shell divided into two compartments by means of a partition. Water entering the inlet passes to one of the compartments, some portion of the water being stored above the compartment. When this compartment is filled and the full unit charge has been received, the portion of water previously stored is automatically spilled into the compartment, thereby putting in operation the siphon which discharges the unit charge and the supply is instantly shifted to the opposite compartment, which in turn fills and empties.

A counter is fitted, which registers each double unit charge delivered by the weigher, and which cannot be tampered with by unauthorized parties. The weigher can be arranged to take water from a pipe line, feed water heater or other source. The weigher is also supplied in connection with a storage tank as shown in the illustration, in which type, a ball float in the tank operates the balanced inlet valve, regulating the supply and keeping the storage tank full of water, or is supplied with balanced valve and float without the storage tank, when desired, and is built in capacities ranging from 750 pounds up to 1,000,000 pounds of water per hour.

Kennicott Water Weigher with Storage Tank.

NEW PIPE WRENCH.

Macdonald & Sons, Ltd., 109 Church Street, Toronto, are just beginning the manufacture of the "Positive" pipe wrench, which is a combination fitting and pipe wrench, particularly adapted for close work. The jaw swings of its own weight, this affording a perfect ratchet action, and making a compound leverage wrench, while throwing the stress equally on all parts of the wrench. This wrench is made of drop forged steel.

SELLING ELECTRICITY BY WEIGHT

When users make a contract with a power company for flat rates on a certain number of sockets the price is usually based on 16 c.p. lamps. The user might use 32 c.p. lamps or less without any intention of defrauding the company, but at the same time he will be using more power than that to which he is entitled.

The object of Shedrick's Electric Light Controller is to "weigh" the amount of power used. Suppose a man had six sockets for 16 c.p. lamps. The controller would be set for this amount and if he used 32 c.p. lamps on three of the sockets and threw in another this would be in excess of his contract and the controller would keep flickering his lights until he got within his limit once more.

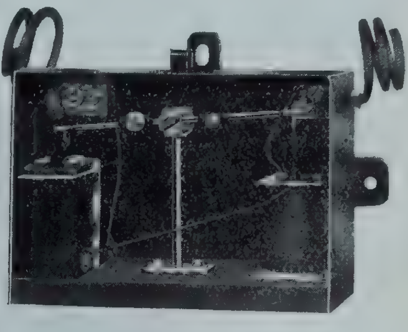


Fig. 1.—Shedrick Controller—open.

The instrument was invented by C. E. Shedrick, Montreal. It consists of a box containing an evenly balanced scale bar resting on delicate bearings. At one end is suspended the core of a solenoid magnet. At the other end a

U-shaped piece of round bar iron dips down into two heavy iron bottles containing mercury and closes the circuit between them. There are two small weights on the crossbar, one of which is stationary and the other capable of adjustment to meet the demand.

When the load exceeds that for which the instrument is set, the iron core of the magnet is drawn down and the U bar drawn up thus breaking the circuit between the two bottles. This done the bar drops back into the mercury closing the circuit. This continues until the excess power is shut off.

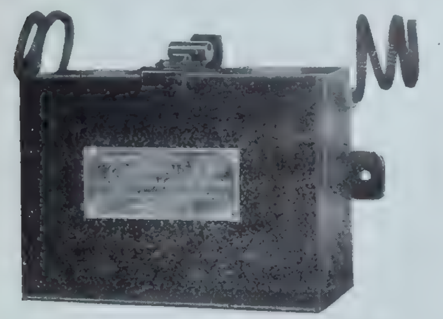


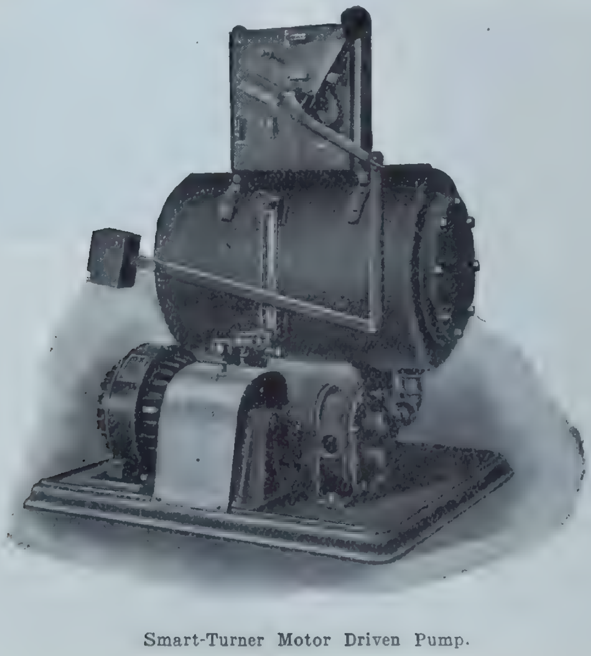
Fig. 2.—Shedrick Controller—Closed.

The instrument is very simply constructed in three sizes: low, for from 1 to 7 lights; medium, for from 5 to 20 lights; high, for from 15 to 50 lights of ordinary 16 c.p. Higher ranges are furnished to order.

The central station man will be interested in this protective instrument while the consumer using one has the privilege of unlimited distribution of a limited number of lights.

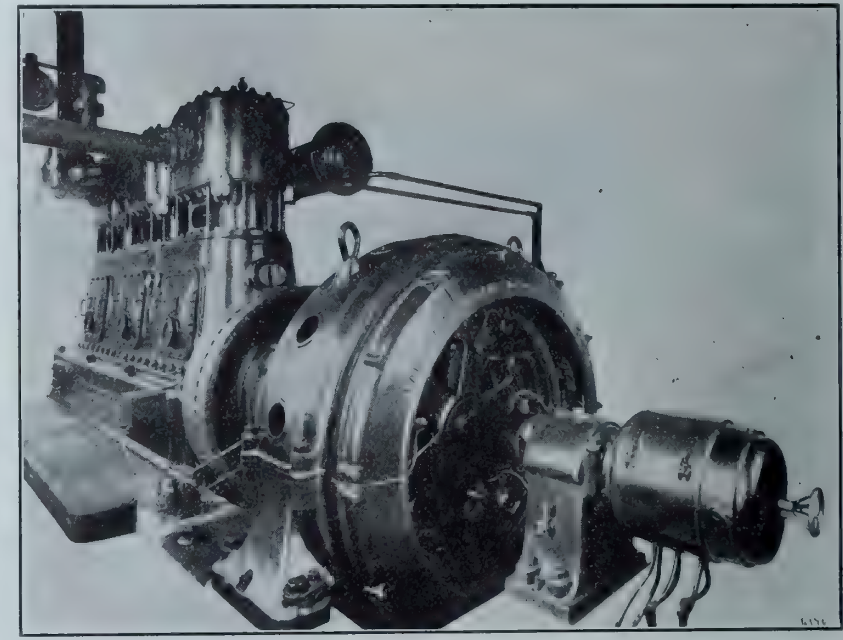
MOTOR DRIVEN PUMP.

The accompanying cut illustrates an automatic feed punp and receiver, equipped with motor driven rotary pump, built by the Smart-Turner Machine Co., Limited, Hamilton. These outfits are specially designed for returning water of condensation to boilers, in plants where the boiler pressure is in the neighborhood of one or two pounds per square inch. The same receiver, with regulating device, etc., may be used in conjunction with either of their Centrifugal, Triplex or Duplex Power Pumps.


Smart-Turner Motor Driven Pump.

AIR COMPRESSOR AND MOTOR.

The accompanying illustration presents very much the appearance of a vertical engine direct connected to a generator, but this is not what the illustration represents. It is an air compressor instalation direct connected to a motor built by the Lancashire Dynamo & Motor Co., with Canadian offices at 152-4 Bay St., Toronto.


An Interesting Motor and Air-Compressor Unit.

The compressor was built by the Tilghman Co. and has a capacity of compressing 2,000 cu. ft. free air to 75 lbs. per sq. in. per minute. It is driven by a 2,200 volt, 350 b.h.p. motor made by the Lancashire Dynamo & Motor Co. The motor is induction, wound rotor type, with brush lifting and short circuiting device on the end of the shaft.

$204,000,000 GOES UP IN SMOKE.

Over a million times during the past ten years we have witnessed the thrilling sight of burning buildings. In the year 1889 this cost United States $123,046,833; ten years later the loss amounted to $153,597,830; while last year $204,000,000 worth of property was destroyed by fire. This constantly increasing annual fire loss has induced engineers interested in fire protection to seek with renewed zeal for all practical methods of lessening the danger of ignition and spread of flames. As a result of this, tile, vitrified facings, terra cotta, concrete construction and numerous other fire-resisting materials have been developed for use in all parts of buildings except the roof, while but few important improvements have been made in roofing materials, notwithstanding the fact that authorities claim that from 27 p.c. to 50 p.c. of the conflagrations are the result of flames being communicated to adjoining buildings by burning sparks and embers falling on an inflammable roof.

Factories, barns, etc., are probably more at the mercy of burning sparks and embers than other types of buildings, because they are usually covered with so-called ready roofings, and nearly all roofings of this type are made of wool felt, rag stock, paper, coal tar and other highly inflammable materials.

There is one roofing of this type, known as J-M Asbestos Roofing, which is being largely used on factories and large buildings, which seems to overcome the objections to all others of this type. It is said to be so fire-proof that it will withstand the flame of a blow-torch for an hour without being injured. This roofing is made by the H. W. Johns-Manville Co., of New York, well known as manufacturers of asbestos products.

The asbestos rock when it comes from the mines is in appearance much the same as other rock. When scientifically crushed, this rock produces long, tough fibres which are woven into cloth for asbestos theatre curtains, made into sheets of felt for roofing, and treated in various ways for making hundreds of different fireproofing materials.

In making this roofing several sheets of this asbestos felt are thoroughly saturated with genuine Trinidad Lake asphalt, well known as a permanent waterproofing material. These sheets are then cemented firmly together with this asphalt, making one homogeneous mass. This, then, constitutes an actual covering of stone, which, because of its all-mineral nature, not only offers to a building protection against fire, water, wind and weather, but which also naturally cannot rot, rust, melt, run or crack, and requires no painting to preserve it.

RADII AVERAGING INSTRUMENT.

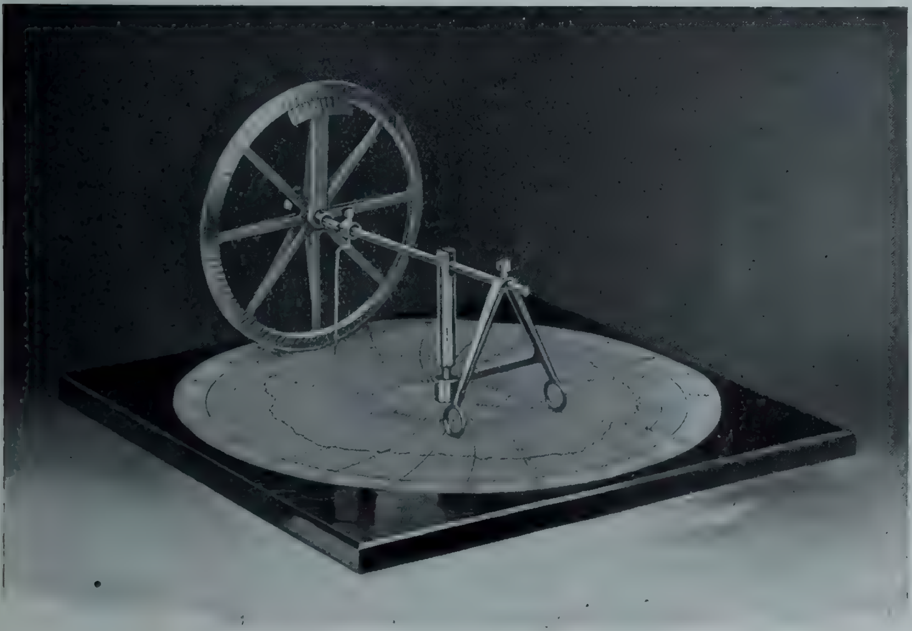
The Bristol Company, of Waterbury, Conn., have for the last twenty years made a specialty of manufacturing automatic recording instruments for pressure, temperature and electricity. Many thousands of these instruments have been put into practical service. As this class of recording instruments using circular charts have come into general use, there has developed a demand for a simple device to quickly determine the average of the record made on such charts, and the integral value for the whole twenty-four hours or for the time covered by the record.

This long felt demand has been filled by the instrument illustrated herewith, which is based upon a fundamental plan as worked out and patented by Professor W. F. Durand of Stanford University, and is constructed in accordance with a novel design recently patented by Wm. H. Bristol, president of the Bristol Company.

The instrument can be applied for averaging records of any kind on circular charts having uniform graduations as, for instance, records of watts, amperes, temperature, pressure, etc. Recording instruments equipped with circular charts are therefore made available for a number of applications for which it was previously thought necessary to use instruments recording on straight lines or strip record charts. Recording differential pressure gauges are coming into use for measuring velocities and volumes of liquids, air or gas flowing in mains, and this integrating device will prove of value for quickly obtaining total volumes of flow for any given period of time.

The simple construction of the instrument is shown in the accompanying illustration. A wooden base with a metal socket is provided for supporting and centreing the chart. The socket holds a rotatable pin with a vertical slot at the top to receive the bar which carries the integrating tracer point and triangular support. The vertical groove in the rotatable pin allows the integrating wheel to roll on the chart with uniform pressure due to its own weight.

The integrating wheel is six inches in diameter, the rim being graduated into one hundred numbered equal spaces, and is fitted with a vernier, which makes it possible to easily read with the naked eye to one tenth of one division on the integrating wheel. The wheel is of such large size it is not necessary to supply any counting device for the number of revolutions. The number of complete revolutions cannot be more than two, even for a record of maximum size on the large 12 inch charts.


Bristol-Durand Radii Averaging Instrument for Circular Chart Records.

To operate the instrument the thumb and fore-finger of one hand are applied to the base of the triangular support, which is moved radially, so as to cause the tracer point to continually follow the record curve, while the chart is turned with the other hand.

By referring to a line plotted on a sheet of cross section paper furnished with the instrument for the particular record curve that is to be measured the total reading for the entire twenty-four hours may be taken off directly.

A full explanation of the theory upon which the operation of the instrument depends has been given by Professor Durand, in a paper presented at the New York meeting of the American Society of Mechanical Engineers in 1908. This may be briefly summarized as follows:

In applying the instrument it is necessary to have a uniform radial scale, from which it follows that equal increments in the length of the radius correspond to equal increments in the watts, amperes, temperature or whatever quantity is measured.

The integrating wheel being carried at right angles to shaft passing through the centre does not turn and give a reading when the tracing point is moved on a straight radial line, but if the tracing point is made to follow a record, the integrating wheel will revolve and the amount of the revolution will correspond to the total of the circumferential elemental components of the record curve, the radial elemental components of the record having no turning effect on the integrating wheel.

As the lengths of the arcs of concentric cicles for given angles or for the entire circumference are proportional to their radii, it is evident that the amount of turning of the integrating wheel, and the reading obtained thereon, will be proportional to the average radius of the record traced.

The instrument is adapted for integrating charts with either straight or curved radial time arcs. The correction necessary for radial time arcs which are curved may be made, after completely tracing the record, by returning the tracing point to a point on the chart having the same radius as the starting point, the movement of the tracing point being along an arc corresponding to the curved radial time arcs.

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A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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WHEN GOOD FELLOWS GET TOGETHER.

The "get together" spirit appears to fill the air during the spring and summer months. There are the annual outings and conventions of the engineering associations, all having in view the exchange of ideas and goodfellowship.

The Canadian Electrical Association decided that this year the convention should be held at the Royal Muskoka Hotel, Muskoka Lakes. It was a happy choice and business and pleasure were so combined, that the business side of the convention did not weigh upon the shoulders of those present with the same seriousness that is usual at conventions.

The Canadian Association of Stationary Engineers will hold their annual convention in Berlin, July 26, 27 and 28. Victoria Hall has been secured and the Exhibitors' Association will have on display all the latest appliances of interest to manufacturers and engineers.

Arrangements have been made with the railroads so that every engineer attending may secure a cheap ticket. Secure a single fare ticket to Berlin with a certificate and obtain the benefit of the cheap fare provided for. These certificates must be presented to John B. Goff, secretary of the C.A.S.E. Exhibitors' Association not later than Wednesday morning.

Besides the large exhibit, the Wednesday evening session will be an open meeting and smoker at which technical papers will be read on important engineering subjects by A. M. Wickens, A. W. Spotton and H. L. Peiler. Every engineer should avail himself of the opportunity to see first hand the exhibit of power house appliances and hear these papers read and discussed. Every manufacturer should see that his engineer visits Berlin during the convention for at least one day, July 26, 27 or 28.

This interchange of thought on problems confronting engineers, introduced by authorities, should be listened to by every engineer. No engineer at this date can remain "sufficient unto himself." Neither has any man a monopoly of ideas. Men whose interests are in the same line, therefore, may derive many advantages from rubbing shoulders with their fellows and from exchanging ideas and experiences.

◆

SELLING SECOND-HAND BOILERS.

Engineers are concerned more or less with the elastic properties of materials. From gage glasses possessing little elasticity to rubber packing rings possessing a great deal, the range is very considerable says Power. The elastic qualities of many of the materials and things that lie within these limits are interesting, but none is more inexplicable or harder to understand than the elasticity of the conscience of the average steam user when he wishes to sell a second-hand boiler. He may be a pillar in the community, and a most conscientious man in all other business transactions, but when it comes to disposing of a second-hand boiler, he seems to take, as it were, a moral holiday, and lets what is unscrupulous in him, and hidden from sight under ordinary conditions, run riot until the boiler is sold.

We would expect such a man to say: "Here is a boiler which has been condemned, and because it is not good enough for me, it is not good enough for you, and it is valuable only as scrap, and I will accept no greater amount than that which its weight justifies, and I have further caused the words 'Condemned' to be stenciled in the front head, so that no unsuspecting person may be led to use this boiler as a steam generator, and thus endanger his life and property and the lives of others." But does he do this? No, he gives the boiler a nice coat of thick tar paint and chuckles at his shrewdness as he palms it off on an unsuspecting public.

Just as all horses offered for sale are three years old, so all second-hand boilers are offered for sale because the plant has outgrown them, and they are now too small for the work. Possibly, this may be the case, and it is possible that the thick coat of tar paint which is invariably given the boiler when it is offered for sale may be in the nature of an affectionate testimonial on the part of the owner in behalf of the good service the boiler has rendered in the past; it may be merely a natural pride in having the object which he offers for sale appear at its best, but we doubt it.

If a factory closes down permanently, and the whole plant is sold piece-meal, then one would be justified in assuming that the boilers offered for sale were in as good condition as the length of time they had been in service would warrant, and in such a case one can expect to pay a reasonable price and not to get a great bargain, but it is seldom that a large plant is abandoned and the machinery sold in this manner, and generally when a second-hand boiler is offered for sale by a concern still in operation, it is because that boiler is no good.

◆

25 CYCLE vs. 60 CYCLE.

Elsewhere in this issue is an article on "Power at 25 cycle versus 60 cycle in Toronto." This article treats on a subject that is of considerable interest at present due to most of the Western Ontario municipalities taking Hydro-Electric power from the Commission, all of which is transmitted at 25 cycle. The conditions prevailing in Toronto being necessarily much the same as elsewhere, the article is of general interest.

Mr. Gulley is in a position to be quite conversant with the conditions as they prevail, being in charge of part of the change-over from the 60 to 25 cycle in Toronto, so that what he states may be looked upon as authoritative.

As mentioned in this article, it is only profitable to change-over where the power users are scattered, as otherwise the cost of the change would be prohibitive, the saving where the transmission distance is short not warranting the extra expenditure of replacing the machine. For that reason, in Toronto, change-overs are only being made east of the Don, and in Parkdale, as in these districts, the industries are scattered. Similar changes have been made in other Western Ontario cities, the power companies changing over, and thereby compelling the power users to change their equipment to suit.

Mr. Gulley shows conclusively that it is much to the advantage of the operating companies to transmit at the lower frequencies, the figures he cites proving his statements.

This article will prove of interest to the majority of our readers, for it does not appear to be generally understood why this general change-over is being made.

◆

LET US AVOID HYPROCRISY.

The extra-provincial tax of British Columbia is a menace to inter-provincial trade. There is no doubt about it, and no one denies it.

It is a sort of McKinley Act levied against the other provinces composing the Dominion.

But while this is true, do not let us who live and do business outside British Columbia play the hypocrite. These British Columbians may be sinners greater than we are in this one respect, but none of us can lay claim to being altogether free from narrow provincial legislative sins of the type which has been placed upon the statute book of British Columbia.

Several of the provinces have rather drastic laws on their statute books in regard to extra-provincial companies. In Ontario, for example, the penalty for non-registration is the same as in British Columbia, namely, $50 a day for the company and $20 a day for the agent or representative. And then some that have not extra-provincial taxes, permit municipalities to levy taxes upon commercial travelers, which is even a more irksome form of taxation.

Wherein the British Columbia Act chiefly differs from similar Acts on the statute books of Ontario, Quebec and Manitoba is in its enforcement. British Columbia seems determined to strictly enforce the law; the other provinces that possess a similar law are in the main unconcerned about its enforcement. The Vancouver Board of Trade has failed to induce the Attorney-General to suspend the operations of the Act for even six months.

The enforcement of the law will certainly interfere with trade relations between British Columbia and the other provinces.

But the tax of $25 to $250, according to the capital stock of the company, is not the worst feature of the legislation. It is its narrow provincialism that is most to be deprecated.

It is nationalism, not provincialism, which should be the aim of every Canadian to develop.

A law which, according to the Attorney-General's own word, declares it to be illegal for a person in British Columbia to order goods from a non-registered company located outside the province, certainly does not savor of nationalism.

Before, however, the business men of eastern Canada seriously undertake the modification of the objectionable British Columbia Act, would it not be well for them to begin at home? Their laws, in practice, may not be as aggressive as that in British Columbia, but they are on the statute book, and as long as they are thereon they can scarcely, with clear consciences, undertake the regeneration of their fellow sinners in the Pacific Province.

◆

BAN ON THE SECRET REBATER.

The secret rebater is becoming more and more unpopular, and it begins to look as if Canadian salesmen were to be divided into two great moral classes—the secret rebater and the honest salesman who depends upon his ability.

The man who stoops so low as to offer a rebate in order to cover up his lack of salesmanship does not deserve the support or glad hand of his fellow traveler. His competition is most unfair; not only that, it is criminal in the eyes of the law.

Recent cases have come to our observation where travelers have declined to recognize their confreres on the street because the latter have been guilty of an offence of the criminal code in respect to secret rebates.

Under ordinary circumstances their action in keeping aloof from their competitors should be discouraged. But in the case at hand are they not justified to a certain extent in ostracising them?

The secret rebater is rapidly becoming unpopular, and rightly so. Business should be done on honest principles —a salesman should rely on his salesmanship ability, the standard of his goods, and the reliability of his house, and not on rebates contrary to the criminal, as well as to the moral law.

◆

A large machine tool company used large quantities of cutting and threading oil in their screw machine and turret lathe departments, buying in barrel and carload lots. It was suggested that they could save money by purchasing their oil in tank car lots and compounding it themselves. A series of tests was conducted with varying proportions of different oil, different prices, and so on. The result showed to their satisfaction where by so doing an oil equal in quality to what they had been using could be had at such a reduction in price as to result in a saving of from six thousand to seven thousand per year.

POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

British Columbia.

REVELSTOKE.—Ratepayers have sanctioned the expenditure of $27,000 on waterworks extensions.

Alberta.

LETHBRIDGE.—P. Burns & Co., Ltd., meat dealers, will equip their branch in this city with an 8-ton refrigerating plant, contract for which was let to the York Manufacturing Co., York, Pa.

STETLET.—John Galt Eng. Co. have charge of the installation of the water works system.

Saskatchewan.

MOOSE JAW.—Gordon, Ironside & Fares, Montreal, have purchased a site here, where they will erect a large modern packing house with coolers, freezers, refrigerating plant, lard plant, etc.

YORKTON.—The council is calling for tenders for the construction of a sewage disposal works.

SASKATOON.—Sealed tenders addressed to the city clerk, J. H. Trusdale, and marked "Tenders for 250 Horse Power Water Tube Boiler," will be received up to and including Monday, July 25th, 1910, until 5 o'clock p.m.

Manitoba.

WINNIPEG.—The T. Eaton Co., Ltd., will equip their meat handling plant with an 8-ton refrigerating machine, furnished by the York Manufacturing Co., York, Pa.

SOURIS.—The ratepayers carried a by-law to expend $200,000 on the construction of waterworks and a sewerage system.

Ontario.

WINDSOR.—$100,000 will be raised for a distributing plant, the city having decided to take 15,000 h.p. from the Hydro-Electric Commission.

PALMERSTON.—Joseph O'Mara, packer, has decided to fit up a public cold storage warehouse of about 250,000 cubic feet capacity and has been granted the subsidy offered for such enterprises by the Dominion government.

HAMILTON.—The Fearman Cold Storage & Warehouse Co. has been organized with F. C. Fearman, president. The company will take over the cold storage department of F. W. Fearman & Co., Ltd., and will greatly enlarge the cold storage facilities.

LONDON.—Tenders will be received by the water commissioners up to noon of the 29th day of July next, for the following—Section "A"—Two 3,000,000 gallon turbine pumps, 250 ft head 750 R.P.M.; Section "B"—Two 250 H.P. 750 R.P.M. self-starting synchronous motors with direct connected exciters; Section "C"—Two 350 K.V.A. 3-phase, 13,200 to 2,300 volt self-cooled transformers; Section "D"—Switch board equipment for "B" and "C"; Section "E"—Switch board equipment for incoming line and outgoing power and lighting line with lightning arresters, etc.; Section "F"—One 25 K.W. single phase, self-cooled 2,300 to 110 volt lighting transformer. Frequency of all current 25 cycles. Form of tender, instruction to bidders, plans and specifications may be procured from O. Ellwood, Secretary, Board of Water Commissioners, or from H. J. Glaubitz, Consulting Engineer, Continental Life Building, Toronto.

LONDON.—Engineer Roberts estimates the construction of a transmission line to Springbank at $9,982.

KINGSTON.—The light and power committee of the council is considering an offer from the Seymour Power and Electric Co., of Campbellford, to supply the city with power at $25 per horse power. The company also asked permission to build and maintain a distributing system here.

New Brunswick.

GRAND FALLS.—A complete waterworks system will be installed here by Powers & Brewer, who have just been given the contract.

MARYSVILLE.—The town council is considering the installation of modern sewage disposal works. A. D. McPherson, town clerk.

BERLIN.—A centrifugal or turbine pump, a storage tank of 70,000 gallons capacity and 3,600 feet of 8-inch cast iron pipe are included in the engineer's estimate of new equipment required in connection with the sewage disposal scheme outlined for the northern portion of the town.

NORTH BAY.—A special committee is considering a report on the question of water supply, prepared by the John Galt Engineering Co. Some new machinery is recommended.

Quebec.

CHAUDIERE CURVE.—A. Leofred, Quebec City, has closed a contract with the council for a waterworks plant to cost $250,000 when completed.

Trade Notes.

TORONTO.—The Chapman Double Ball Bearing Co. received an order from the Toronto Carpet Mnfg. Co., Ltd., of Toronto, for the bearings for their new addition.

HAMILTON.—The Smart-Turner Co. report the following orders for their pumps of duplex, simplex, centrifugal, etc., design: two to D. Sullivan & Sons, Red Bank, N. B.; St. Lawrence Paper Mills, Mille Roches, Ont.; one to Edwin Crabtree, Crabtree Mills, P. Q.; Wagstaffe, Ltd., Hamilton; Arthur A. Ward, Moxie, B. C.; Foley-Reiger Pulp & Paper Co., Thorold; W. H. Weller, Port Colborne; W. Hamaker, Port Dover; W. Harris & Co., Toronto; J. W. Holmes, Nelles Corners; Standard Vinegar Co., Stouffville; Great Lakes Dredging Co., Port Arthur. They also report the sale of a jet condenser to Frank Low, Ottawa, and a pumping engine to Chatham.

Toronto University Heating Plant.

The contracts for the new central lighting and heating plant for the University of Toronto, amounting to approximately a quarter of a million dollars, have been awarded by the Board of Governors of the University, and work will be commenced at once.

The most important portion of the new system—the power house and the connecting tunnels—was awarded to L. K. Comstock & Co., New York. In addition to erecting the power house and building the tunnels, Comstock & Co. will supply some of the machinery.

The contract for the boilers was awarded to Babcock & Wilcox, while W. J. McGuire, of Toronto, secured the contract for the heating mains.

The work, which is in charge of architects Darling & Pearson, will be carried forward as rapidly as possible. The plans of the power house, from which all the University buildings will be lighted and heated, are unusual, in that the building will be almost entirely below the general level of the University grounds. It is being built in a small ravine and only the roof will be visible.

The heating plants now in the various buildings will be removed, but the contractors are expecting to make use of a great deal of the material in them.

BOOK REVIEWS.

ELECTRICAL POCKET BOOK.—Size 3½ x 5½ ins., pages 560; numerous figures. Bound in cloth 1s net, in leather, gilt edges, 1s. 6d., net, postage 2d. extra. Published by the Practical Engineer, Technical Publishing Company, 55 and 56 Chancery Lane, London, W. C.

This is 1910 edition of a valuable pocket-book, and has been enlarged and improved. It contains so much useful information that a summary is impossible. Every electrical feature is dealt with, and also such things as power house equipment—in fact everything at all connected with electricity directly or indirectly. The information contained is arranged in very convenient form for ready reference, and is so concisely put that no time need be wasted in finding the necessary information. Every person connected in electrical pursuits ought to have a copy.

ELECTRICAL MACHINERY.—Size 9 x 11 ins.; pages 165; illustrations, 268; bound in cloth.

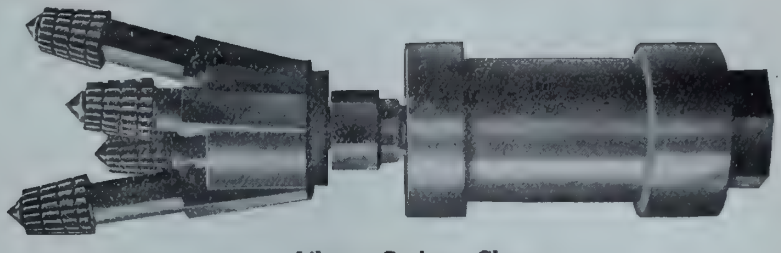
The General Electric Manufacturing Company, of Sweden, represented in Canada by Kilmer, Pullen and Burnham, Toronto, have issued the above book, which deals in a very comprehensive manner with the manufacture and installation of electrical machinery. The book describes the formation of this company, giving the various stages in its development, and then proceeds to deal with the electrical problem itself. There are well written chapters on the following subjects:—Organisation and Works, Development of Manufacturing Methods, Development of Continuous Current Engineering, Development of Alternating Current Engineering, Some Installations and Power Schemes, Switch Board Apparatus and Special Devices, Electrical Traction Installations for Continuous Current, Single Phase System for Electric Traction, Electric Sifting and Transporting Devices, and a final chapter on the Social Institutions of the company. From every standpoint the book is of interest to the electrical engineer or contractor, for all kinds of installations are given, including some of unusual size, particularly in connection with hydraulic development.

"Unit Coal and the Composition of Coal Ash," by S. W. Parr and W. F. Wheeler, is issued by the Engineering Experiment Station as Bulletin No. 37. This is a report of a series of experiments on coal, together with a tabulation of calculated values for unit coal for Illinois, Ohio, and other coal regions of the United States. The results show great constancy in the value of unit coal for any given mine or region, notwithstanding the fact that the value of the natural coal as mined may vary between wide limits. Copies of Bulletin No. 37 may be obtained gratis on application to W. F. M. Goss, Director of the Engineering Experiment Station University of Illinois, Urbana, Illinois.

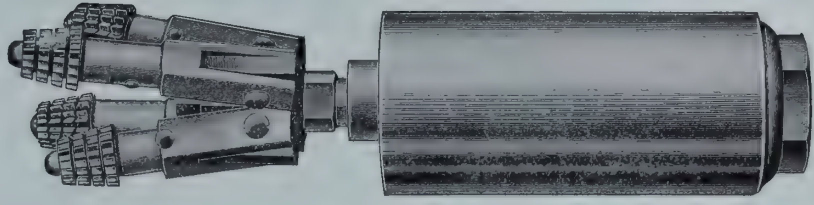
CATALOGUES.

SINGLE PHASE MOTORS.—Circular No. 1153 of the Canadian Westinghouse Co., Ltd., Hamilton, is about their type A single phase motor, which is automatically self-starting with full load. The circular describes the construction of the machine and then goes on to give some of its operating characteristics. It is specially adapted for either remote or automatic control, and has a high power factor and efficiency within a wide working range. They will start and attain full speed at full load, with the current

Liberty Twin Strainer



Liberty Cyclone Cleaner



Liberty Turbine Cleaner

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There's one sure way of increasing the efficiency of your plant—get the full benefit of Liberty Power Plant Accessories. Hundreds of power users testify to their reliability, strength, durability and utility. Why not fall in line with them? Take the four illustrated:

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Write for large Liberty Catalogue, which contains detailed descriptions of our Feed Water Regulators, Tube Cleaners, Oil Purifiers, Separators, etc. Sent free to Engineers on request.

Liberty Oil Separator

The Liberty Manufacturing Co'y

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never exceeding one and half times full load current. As starting torque per unit current is high and acceleration rapid, the maximum starting current is only momentary.

TUBE CLEANERS AND HOSE FITTINGS.—An attractive 24 page catalogue, issued by the Chas. A. Claflin & Co., 60 High Street, Boston, Mass., deals with the various types of boiler tube cleaners and steam hose fittings that they manufacture. Both cleaners and fittings are fully described, many illustrations being used. These articles in actual operation are also shown, as well as photos of other makes, pointing out the superiority of their line.

AIR COMPRESSORS.—Class "O" Duplex Steam Driven Air Compressors, is the title of a recent 24 page pamphlet of the Ingersoll-Rand Company, 11 Broadway, New York. This machine is very fully described in a general way in this publication, many illustrations, several of which are comprehensive cross-sectional views, are made use of, making the booklet much more useful as a reference. An idea of the scope of the booklet may be gleaned by citing the various headings :—General Type, Simplicity, Automatic Features, Accessibility, Cleanliness, Adaptability, Ease of Installation, Duplex Characteristics, Oiling System, various detailed description of parts, Volumetric Efficiency, Large Capacity, Compression Efficiency, True Standard of Compressor Cost, Air Intake Connections, Regulation, and Standard Classifications. Tables of sizes and capacities of machines for various conditions are given, which are of interest to the prospective purchaser.

AIR COMPRESSORS.—Another 24 page pamphlet issued by the Ingersoll-Rand Co., 11 Broadway, New York, describes their class "O C" Duplex Borliss Steam Driven Air Compressors. With the exception of the steam end, the description is practically the same as the class "O" compressor noted above.

WESTINGHOUSE FAN MOTORS FOR ALTERNATING CURRENT.—Is the title of a very neat little booklet issued by the Canadian Westinghouse Co., Hamilton, describing their various types of A. C. office, store and factory fans. A very complete line is manufactured by them for nearly every commercial frequency. Controlling apparatus, such as speed regulators, are also listed.

EXHAUST FANS.—Exhaust fans should not require attention. When they are used they are as a rule merely accessories and there is other machinery that demands, and should demand, most of the operator's time and attention. With this fact in view, it is important that the fan be driven by a well constructed motor. The motor must be as nearly as possible proof against any occurrences that interfere with continuous and efficient operation, and indeed it should be practically "fool-proof." The danger of commutator trouble and burning out of the bearings, and many other features must be carefully considered in choosing the motor on whose operation the operation of the fan depends. There is a good deal of information for buyers in a pamphlet on exhaust fans, which has recently been published by the Crocker-Wheeler Co., of Ampere, N.J. A copy will be gladly sent on receipt of request. Ask for Bulletin No. 124.

PUMPING MACHINERY.—The American Steam Pump Co., Battle Creek, Mich., have issued a handsome catalogue No. 18 of 188 pages, neatly bound, describing steam and power pumping machinery, including March steam pumps and air compressors, American simple and compound pumps, and American power pumps and air compressors. The catalogue is divided into eleven sections, each section being devoted to a particular line. For instance, section 1 deals with boiler feed pumps, 2 with tank and vacuum pumps, etc.

PACKING.—Catalogue 3 from Clement Restein Co., Philadelphia, Pa., devotes 159 pages to a description of Belmont Packing for steam, water, ammonia, hydraulics, oil, gases, acids, etc. The various shapes are illustrated and described.

LUBRICATORS.—A 36 page catalogue from the Stirling Lubricator Co.,1 Frank St., Rochester, N.Y., describes and illustrates the Stirling lubricator of various designs. Prices are included in the catalogue.

ATTACHMENT PLUG.—The Benjamin Attachment Plug is the subject of a circular recently issued by the Canadian General Electric Co., Toronto.

GRAPHITE.—A folder from the International Acheson Graphite Co., Niagara Falls, N.Y., describes unctious Acheson-graphite.

LINE WORK.—The following circulars in connection with the erection of line work, etc., have been received from the Canadian General Electric Co., Toronto : "Trident" 3-bolt guy clamps, gasoline torches and fire pots of various designs, guy setters or anchors, etc.

CONCRETE CULVERTS.—The Dominion Concrete Co., Kemptville, Ont., have issued a neat illustrated catalogue on coated paper giving tests and descriptions of concrete culverts, reinforced pipe, etc., for municipal, factory, power plant and railroad work.

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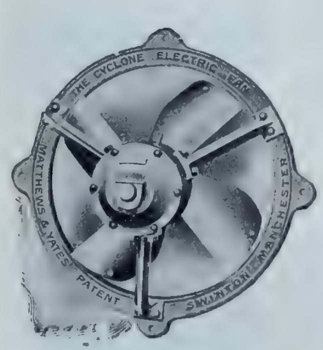

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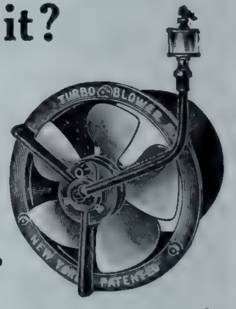

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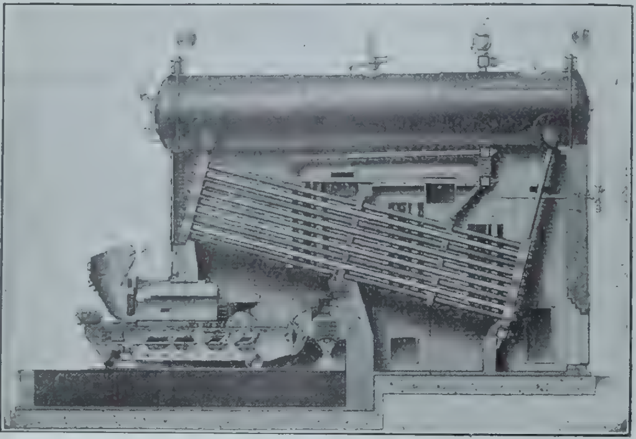

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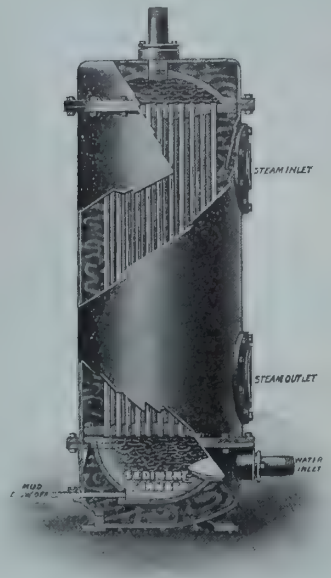

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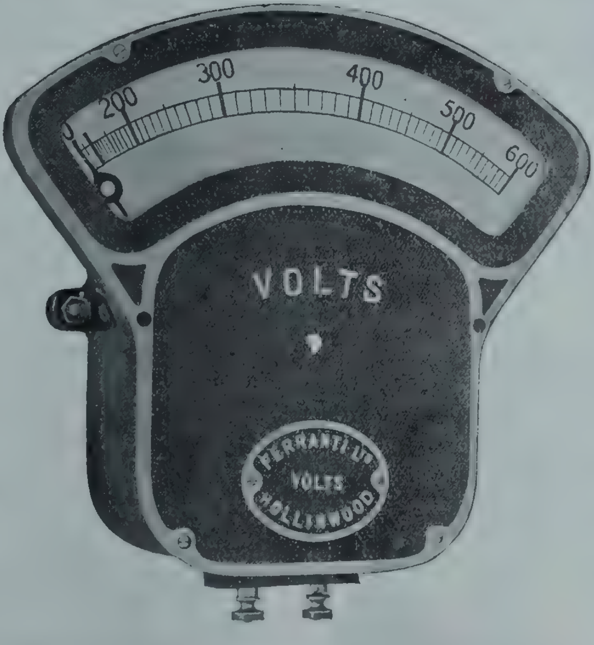

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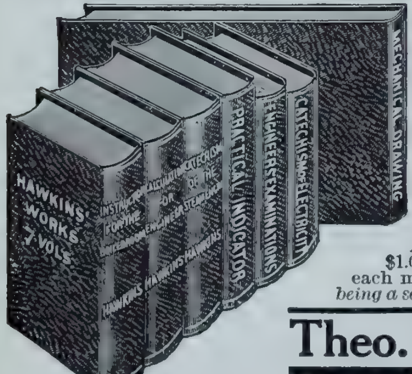

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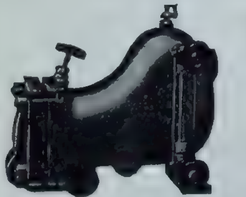

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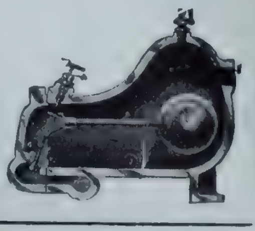

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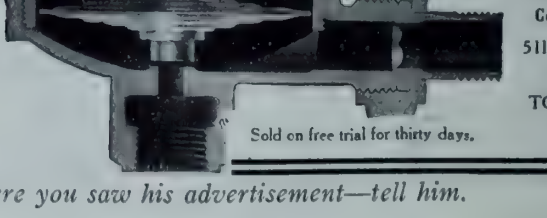

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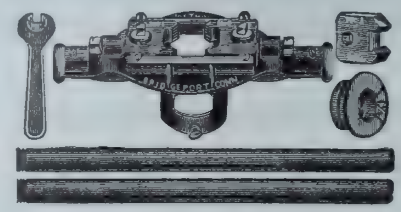

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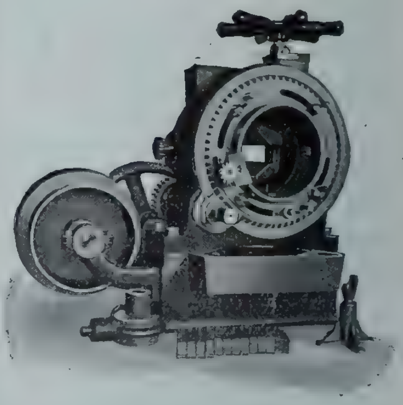

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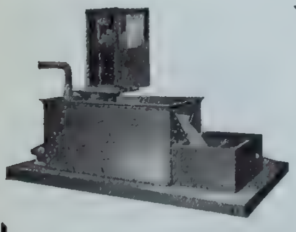

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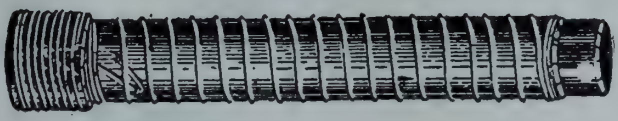

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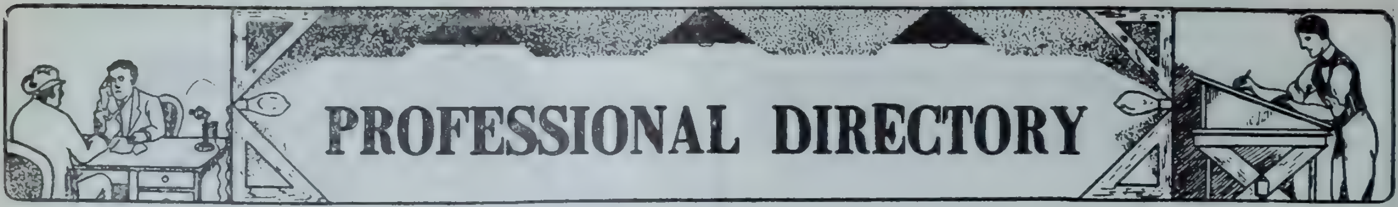

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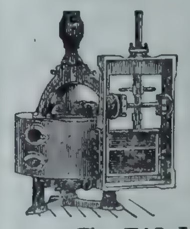

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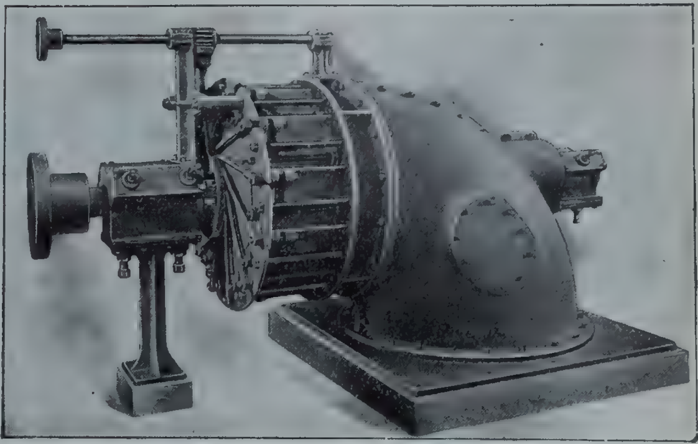

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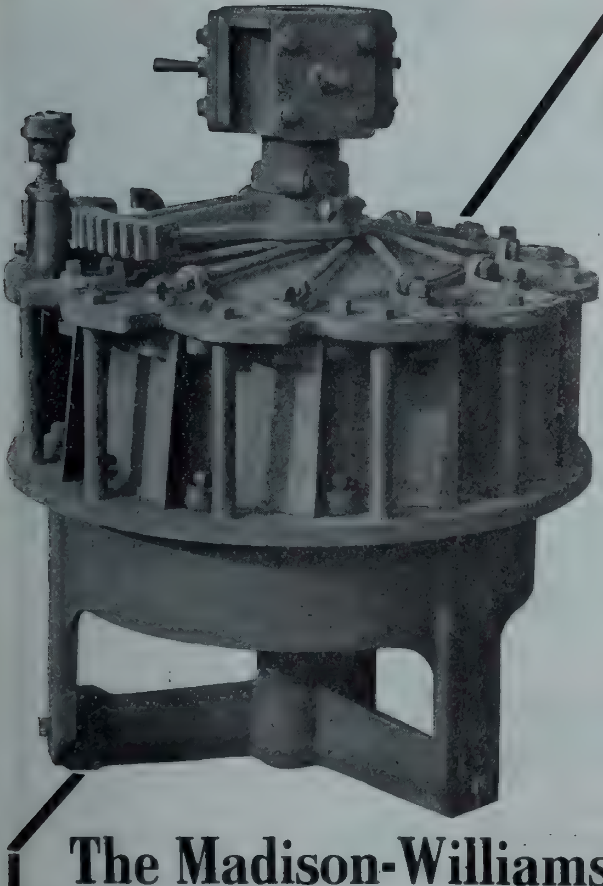

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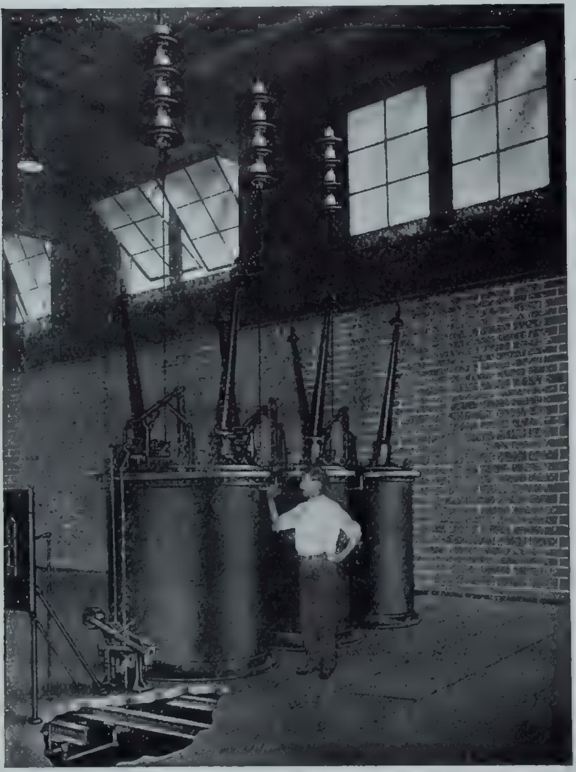

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See Catalogue Section 132

Switchboard Instruments

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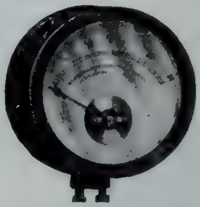

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Our superior facilities enable us to repair all kinds of

Motors, Generators, all Station Equipment, Either Direct or Alternating Current, Starting Apparatus, Commutators, Fields, Armatures, etc.

OUR SOLENOID SWITCHES were originally designed for use in Merritton, Ont., to meet the views of Mr. C. H. Mitchell for a simple, reliable switch. They are now perfected both for 25 and 60 cycle. These Solenoid or remote control switches save wiring and line loss, are compact and have only one moving part, and will operate with certainty with a drop of 15% in line voltage.

The Electrical Maintenance & Repairs Co.

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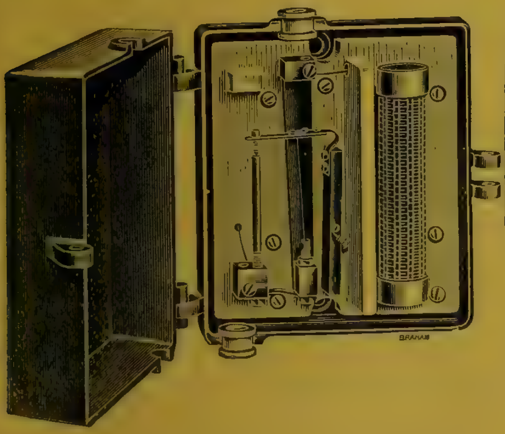

PROTECTION

For Electric Lighting Companies

The N.C.S. THERMAL LIMITER

(PATENT)

protects the company in all cases where light is paid for on the flat rate system. It warns the consumer when he is exceeding his contract and also makes it impossible for him to continue to use light until he has reduced the demand to the agreed limit.

The ***N.C.S.*** Thermal Limiter consists of two bars with a wire attached to a spring contact; the bars are of iron, as is also the wire; this arrangement ensuring absolute compensation for anychanges of temperature. It is free from self induction, and equally suitable for Direct Current or Alternating Current circuits.

The whole apparatus is mounted on a china base and enclosed in a cast-iron case, and is so arranged that it can be sealed. It can also be used in conjunction with a fuse box.

THE WAY IT WORKS

is as follows:--When the candle power is exceeded by switching on an additional lamp, the extra current will cause the wire to expand and open the contact at the extremity of the spring. This puts a resistance into the circuit, thus dimming the lamps, and at the same time the wire cools, and closes the contact again; and thus the cycle of operations is repeated. This produces continual flickering of the lights, which will cease as soon as the additional lamp is switched off. A condenser is arranged across the gap to prevent any sparking which might otherwise ensue.

CHAPMAN & WALKER, Limited

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The Genuine
Hancock Inspirator

The Hancock Inspirator—a double tube boiler feeder requiring no adjustment under varying steam pressures

The J.M.T. Valve

The J.M.T. Injector combines all the best features in Injector construction, and operates under the widest range of steam pressure.

The J.M.T. Injector

Steam Specialties

In an age of specialization we feature the best qualities known in Engineers' Supplies, with few in sight to compare with

J.M.T. Injectors
Hancock Inspirators
J.M.T. Valves

together with Steam Gauges, Stop Cocks, Safety Valves, Steam Whistles and Engine Equipments generally. The fact of a steady growing trade indicates best how Morrison Specialties "Make Good." They speak for themselves wherever introduced.

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Special Feature—Report of C.A.S.E. Convention

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power; and to the operation of Refrigerating Machinery.
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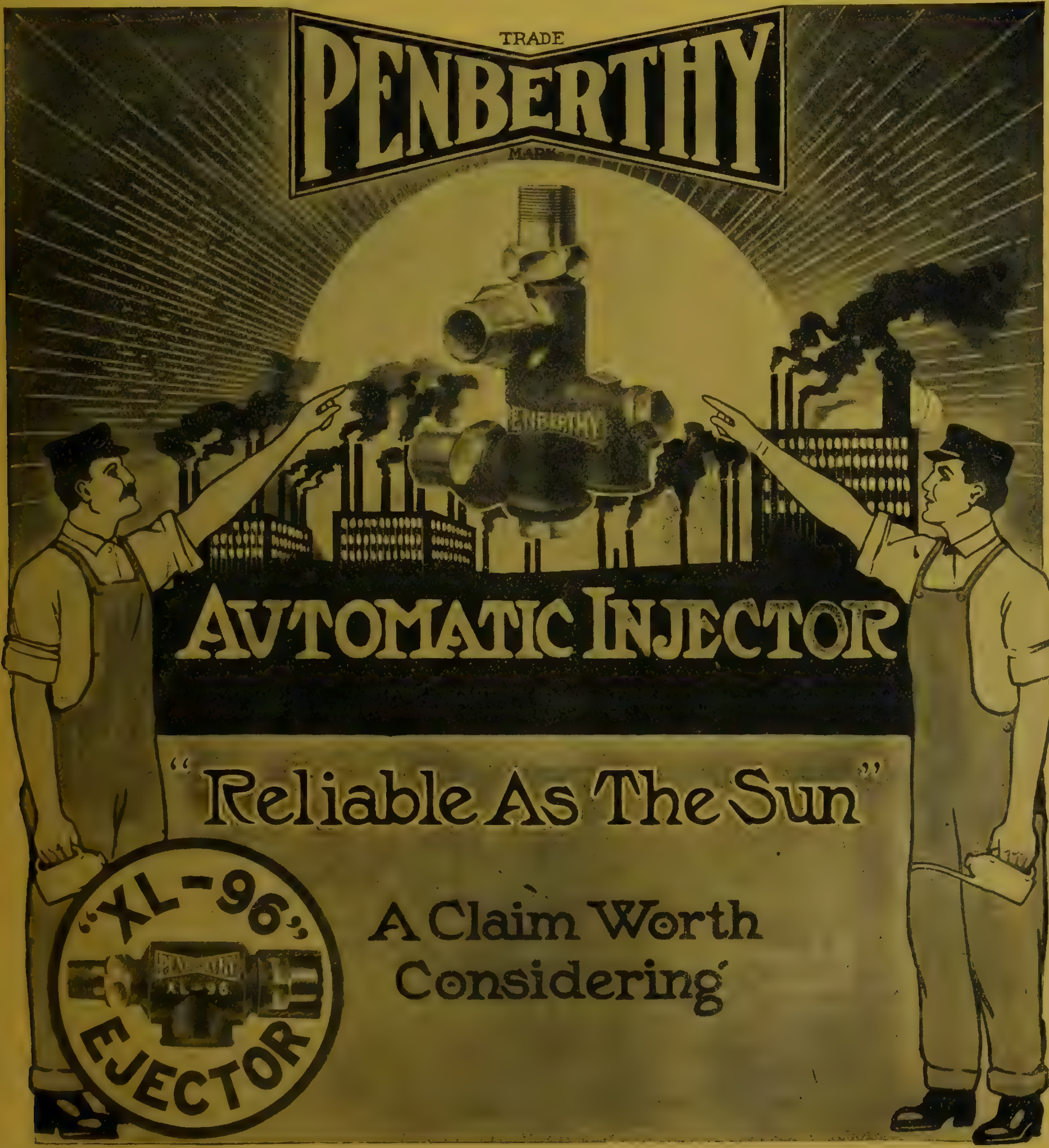
MONTREAL: Eastern Townships Bank Bldg. TORONTO: 143-149 University Ave WINNIPEG: 511 Union Bank Bldg
LONDON, ENG.: 88 Fleet St. E.C

Vol. III. Publication Office, Toronto—August, 1910 No. 8



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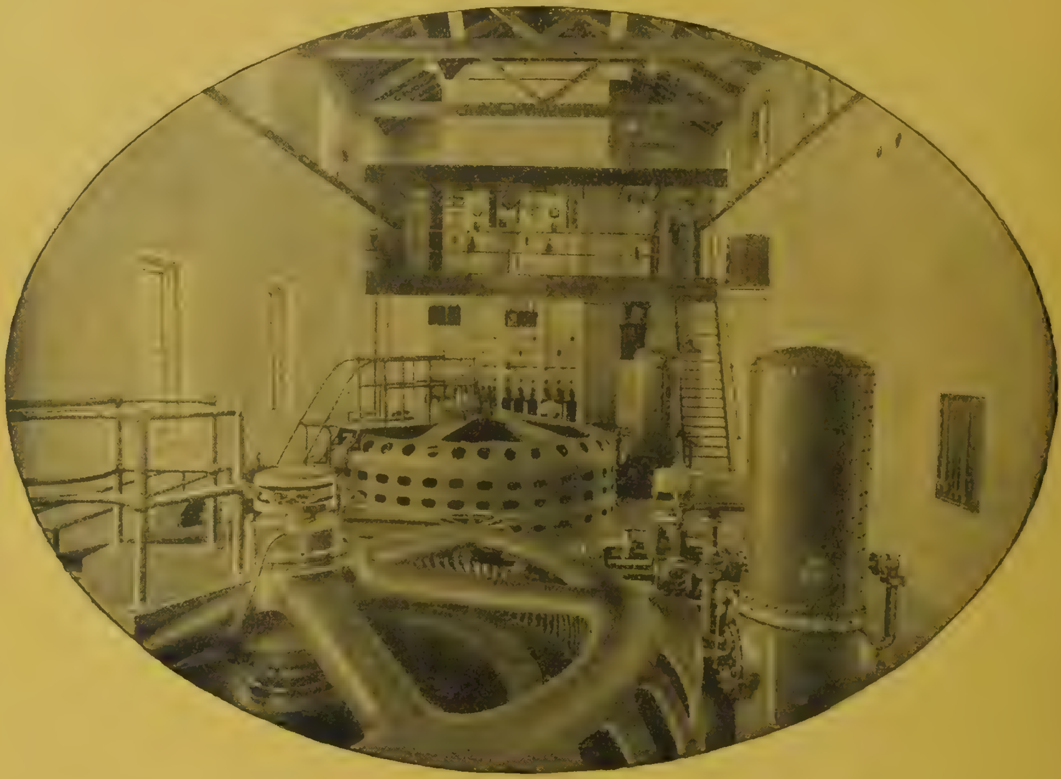
Both Turbine and Generator are constructed and tested under the supervision of the engineers who designed them and who are thoroughly familiar with the conditions necessary for their successful operation as one unit.

With a given amount of water WE GUARANTEE a definite electrical output.



MUNICIPAL POWER PLANT, NELSON, B.C.

including Water Wheels, Generators, Switchboard, Transformers and other auxiliary apparatus built in our shops in Montreal.

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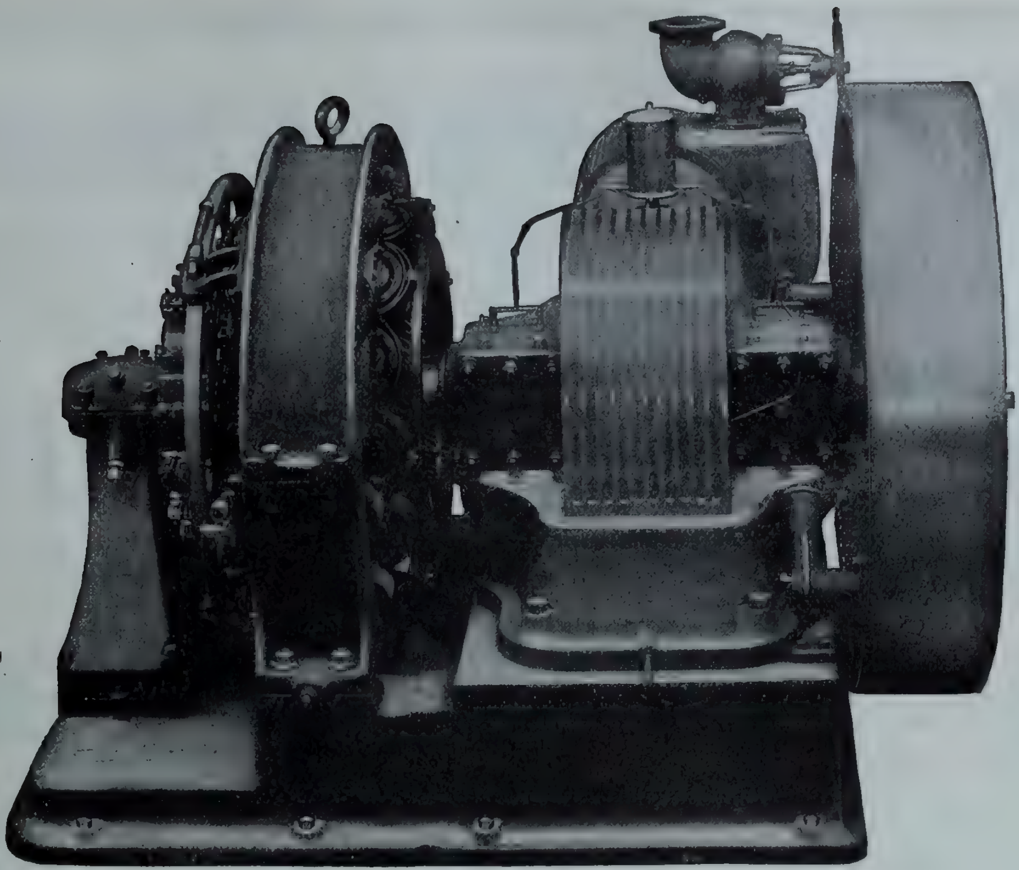

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FOR ELECTRIC LIGHT AND POWER

An automatic High-speed Engine that for economical production of electrical energy has never been surpassed. Built to be simple, compact and easily accessible, it combines these qualities with ease of operation, smooth running and regulation that is practically instantaneous. Fitted with the Begthrup Inertia Governor, is equally sensitive when running light or under full load.

Built in simple or compound from 40 to 700 h.p

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Demonstrated superiority is undeniable

The reason why so many of the largest Power Plants in all parts of the world have installed the

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is because in point of efficiency, economy, durability and safety it is ***without a peer.***

The ***Heine Boiler*** is economical because it delivers ***dry steam*** at the boiler valve by separating all water from the steam. Moreover, the "Heine" has a wonderful capacity for absorbing and transmitting heat.

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Every conceivable test is applied to the boiler, both in course of construction and when completed, and absolute safety may be guaranteed even at highest pressures.

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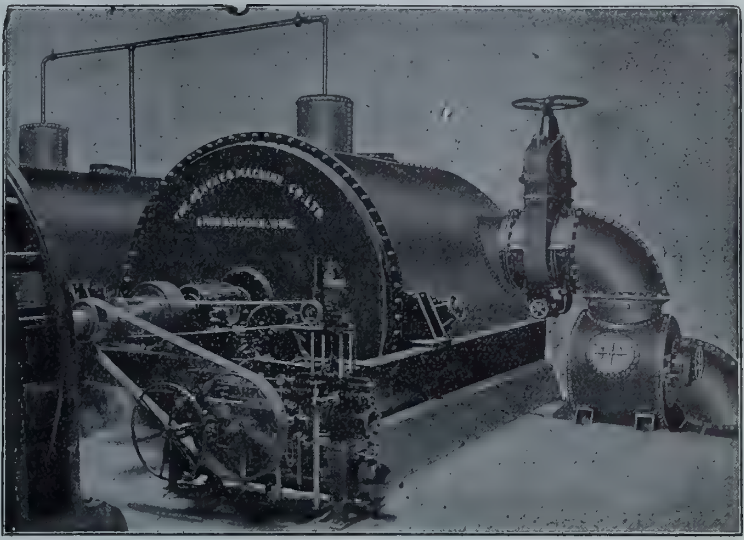
is perfectly adapted for Hydro-Electric Installation.

We build it in all sizes and arranged for any setting.

We invite inquiries and will send our catalogue on request.



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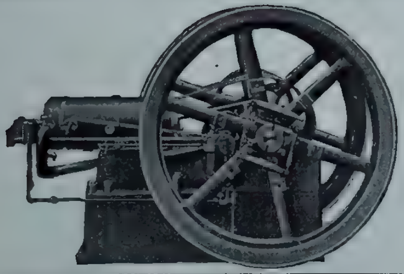

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I H C construction is simple—few parts—each part amply strong.

I H C construction is exact—each part fits perfectly—works perfectly—no missing fire—no wasted fuel.

I H C construction is correct—all gasoline is perfectly vaporized—highly compressed—immediately fired—obtaining most power from least fuel.

I H C construction is accessible—every part can be easily cleaned and kept in perfect order.

I H C construction will give you most power—at least cost—with least trouble—for longest service.

The I H C line contains an engine for every need—1 to 25 horse-power—vertical or horizontal—stationary, portable (on truck or skids), or tractor. You can easily choose just the engine you want. Investigate these points for yourself. Write us for catalogue and full particulars.

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Regarding a Canadian Electric Lighting Station a well-known firm of Consulting Engineers writes:—

> "Since taking charge of this plant, we have investigated the record of these engines (all Belliss & Morcom), and find that during the three years of their operation they have given absolutely no trouble whatever, and we may say that it has hardly been necessary for our engineer to adjust the engines, which are on 24-hour service and running practically continuously in an engine room heated in summer to a temperature of 110 degrees."

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Shall we send you catalogue of Belliss Engines and Turbines?

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Get the maximum results

from the cheapest kinds of fuel (Soft and Hard Coal Screenings, Hard or Run-of-mine Coal), by burning it on

"THE Cyclone"

Shaking and Dumping Grate Bar

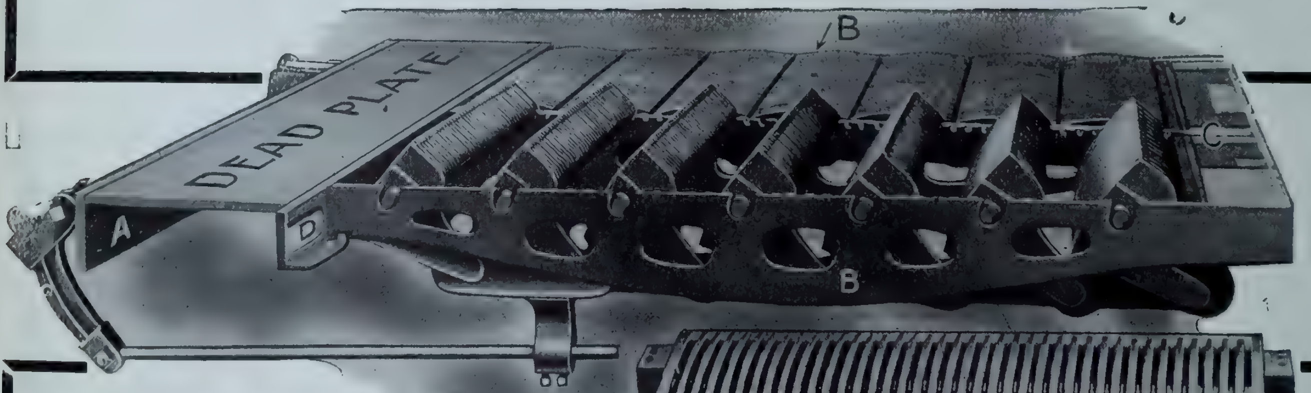
In addition to greatly improved mechanism, which keeps the "Cyclone" free from clinkers and prevents waste of fuel, this grate has no less than 68% of air space, and 90% underdraught.

It will generate more steam from the amount of fuel consumed than any grate in the world, locks level, cannot get out of adjustment, and will never warp. Read what one delighted user says of the "Cyclone."

Don't be content to rub along in the old way, when the "Cyclone" — the incarnation of economy and efficiency—is at your service.

Write to-day for illustrated circular

> Canadian Steam Boiler Equipment Co. Toronto.
>
> GENTLEMEN:—We are sending you to-night, through our Head Office in Montreal, an order for another set of Cyclone shaking and Dumping Grate Bars for one of our boilers. We are glad to say that we have no reason whatever to regret the installation of the first set of these bars. We have now had them in operation several months, and find we get more perfect combustion and much better fires and greater economy in our use of coal with these bars than we have had from any system of firing that we have tried at this Mill. It is our intention, during the coming summer months, to complete the installation of these grate bars under our other four boilers.
>
> Yours truly,
>
> The Canadian Colored Cotton Mills Co. Ltd., St. Croix Mill.
>
> J. W. GRAHAM, Manager.



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CONDENSING PLANTS

OF EVERY DESCRIPTION

Prices and full particulars from

The Canadian Boving Co., Ltd.

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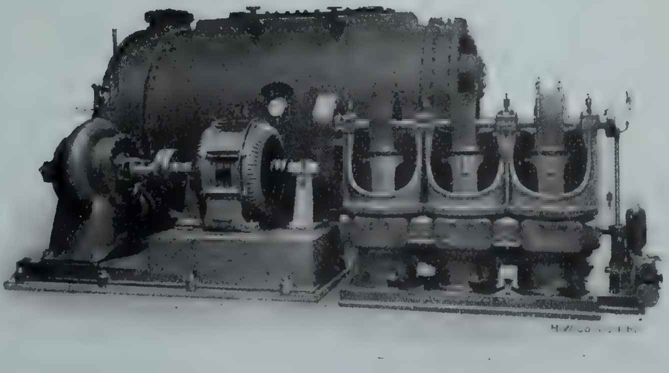
COUNTER CURRENT CONDENSERS
Barometric and low level jet or surface.

MIRRLEES-EDWARDS AIR PUMPS
No foot or bucket valves. Simple, low power required and accessible.

DRY AIR PUMPS
Single and two stages.

ANY CAPACITY
HIGHEST VACUUM



THE COST OF SMOKE

¶ What proportion of the coal fed to the locomotive is actually used in power?

¶ About 6 per cent.; the rest is wasted.

¶ What part of the fuel value of their coal do the furnaces of the great manufacturing plants actually apply to driving the machinery?

¶ Not over 10 per cent.; often less.

¶ The rain of cinders from the locomotive, the pillar of black smoke from the factory chimney, account conspicuously for the waste. The great loss, however, is in the form of unconsumed gases which escape into the air without having been of any steam-producing value.

¶ These gases escape because, as is well known, perfect combustion has never been discovered as yet. The gases escape from the coal so rapidly that, before they are mixed with the necessary air (providing oxygen) they have passed away from the point of combustion—which is at the surface of the burning coal.

¶ The rescue of a small proportion of the 90 per cent. of fuel value thus wasted would mean a large proportion of the 10 per cent. now ordinarily used.

¶ This should be easily done.

¶ It has been done, and is being done. It can be done in every plant—in yours with the rest. Chemistry has produced in the *FISHER FUEL ECONOMIZER* a substance which when applied to the coal forms an exceedingly thin film over it and causes the valuable heat-producing gases to be held in the coal itself, and the coal and the gases are consumed together, thus preventing the waste of valuable gases which take place when the coal is consumed without the treatment.

¶ Indisputable evidence is available that by the use of

FISHER FUEL ECONOMIZER

Black smoke and flying cinders are eliminated, which has been proved on locomotives pulling the fastest passenger as well as the heaviest freight trains. Many evaporation tests in the power plants of the largest corporations in Canada show increase of efficiency ranging from 10 to 25 per cent.

¶ We save money for the factory owner and railway.

¶ We save the fireman much hard and dirty work.

¶ We save the black smoke which pollutes the air.

¶ We reduce your ashes and clinkers half.

¶ We increase and maintain steam to a degree which is impossible without the economizer.

¶ We keep your boiler tubes and grate bars clean, reducing expense of upkeep.

Let Us Prove It to You. Write To-day for Information

Phone Main 2390

Fisher Fuel Economizer Limited

Head Office, 74 Bay St., Toronto, Ont.

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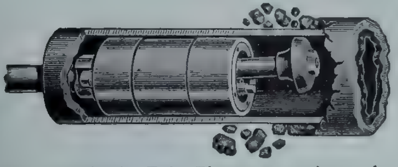
Saved $2 a Week on One Boiler

Doesn't seem much but multiply it by 52 and it's quite a bit. That's what one concern made by using

The Dean Boiler Tube Cleaner

Where there are several boilers and the scale heavy the Dean has saved $150.00 to $1200.00 a year.
That's why we can afford to guarantee to every purchaser that the Dean will pay for itself in six months' use.
Why not try a Dean in one of your boilers and see how much you can save.

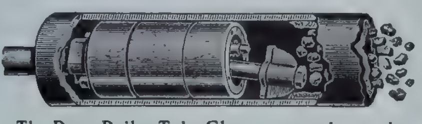
Write for booklet No. 130 and our free trial offer



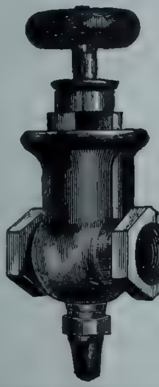
The Dean Boiler Tube Cleaner removing scale from the tube of a return tubular boiler.

THE WM. B. PIERCE CO.

330 Washington Street, Buffalo, N.Y.
Montreal Office : 230 Coristine Bldg., Montreal.



The Dean Boiler Tube Cleaner removing scale from the tube of a water tube boiler.



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On Your Engineering Specialties

It is your protection against poor goods and poor service. See that you get it.

Balanced Steam Trap	**Damper Regulator**
Return Steam Trap	**Temperature Regulator**
Expansion Trap	**Improved Pressure Regulator**
Separator	**Tank Governor and Pump**

These and other specialties described in our catalogue. Write for a copy.

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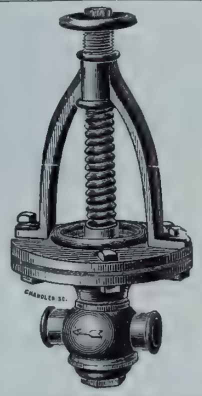
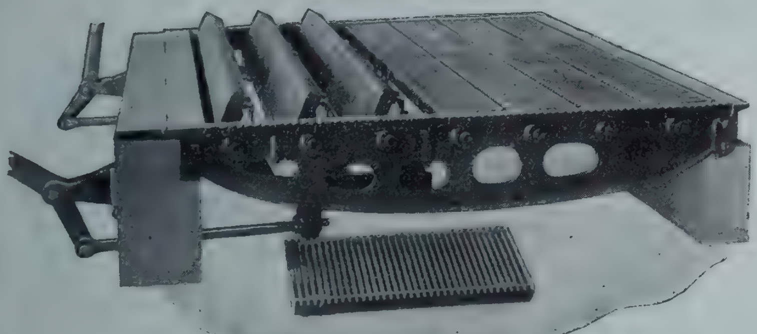


"CAPITAL" SHAKING AND DUMPING GRATE

PATENTED 1910



A comparison of this grate with other shaking grates will show many advantages; the bearings are 3½ inches below the fire, thus ensuring against their burning out rapidly, the sections are easily removed and replaced at low cost, easily operated, greater air space. Send for particulars to

Butterworth Foundry, Limited

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YOUR BOILER Will NEVER BE in GOOD ORDER

So long as you use half measures trying to get rid of scale!

You can't afford Scale in your boiler; it means coal waste, time waste, burnt tube ends, bagging, corrosion and other evils.

The Dearborn Individual Treatment

of your feed-water will keep your boiler in good order---in constant good order, by getting rid of all scale-forming elements.

Send a gallon of your feed-water along. We will, after analysis, prescribe a treatment that we will GUARANTEE to free your boiler from scale.

Send along that sample gallon to-day, and we will tell you how much Dearborn Treatment for your particular case will cost.

Dearborn catalogue sent free

Dearborn Drug & Chemical Works

ROBERT F. CARR, President

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Don't Waste Time

or expense cleaning scaly tubes! any money spent in preventing scale is a far more profitable outlay than what it costs to remove the scale after it has formed. Prevent scale by using

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BOILER COMPOUND

But we can't work in the dark; we must find out what your feed water contains before we can mix the compound that will eliminate the scale-forming salts. Express us one gallon of your feed water; we will analyse it *free of charge,* and will forward a TRIAL SAMPLE of our compound guaranteed to banish all your Scale Troubles.

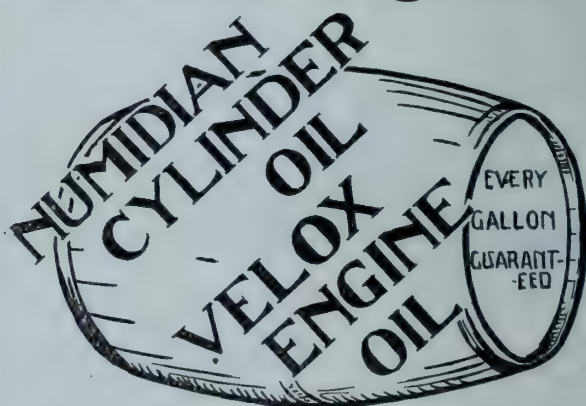
You can make money acting as our agent. Write for details of our offer.

Get in touch with us to-day.

International Boiler Compound Company

144-146 West Michigan St., Chicago, Ill., U.S.A.

The World's Famous Lubricating Oils



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Oils and Grease of every description

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Eliminate Trouble

in your Boiler Room by using the devices illustrated

The "P.H.B." Quick Closing Water Gauge

insures against burns and scalds. A pull of the chain shuts off both steam and water in case of a broken glass. **Sent on Trial.**

The "TORNADO" Steam Boiler Tube Cleaner

Works rapidly, thoroughly and economically. Carries no moisture to wet soot, and blows through the longest tubes.

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is simple, efficient, economical and quickly repaired. Guaranteed unleakable for years. Here are a Trio of Appliances every Boiler Room should have!

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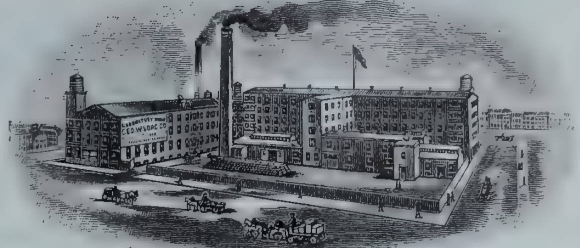

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An Investment Not an Expense

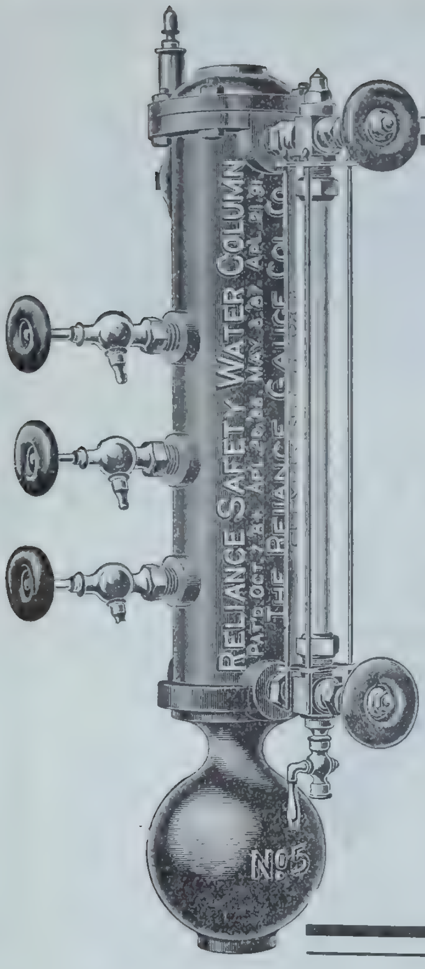
HAVE YOU considered that a good boiler compound will pay for itself by removing the scale in your boilers and thus enabling them to steam better and quicker? This means a saving in your fuel and repair bills.

If you are interested, mail us a sample of scale from your boilers or a gallon sample of your feed water, and we will send you a Certificate of Analysis and a full report, free of charge.

Remember that an analysis of water will cost you from $15 to $25 in a private laboratory

When you are in need, why not give us a trial?

George W. Lord Company
2238 North Ninth Street
Philadelphia



The

RELIANCE

Safety Water Column

There is no more simple, economical and dependable means of protection against boiler explosions than the ***"Reliance" Column.***

As long as the whistle is quiet, the engineer knows that the water in the boiler is being carried at the proper level. The blowing of the whistle gives notice of danger to the engine from too much water or danger from explosion owing to too little water.

Should be in every Boiler House

Our illustrated catalogue is free.
Send for a copy to-day.

The Reliance Gauge Column Company

5902 Carnegie Avenue, Cleveland, Ohio.

GARLOCK

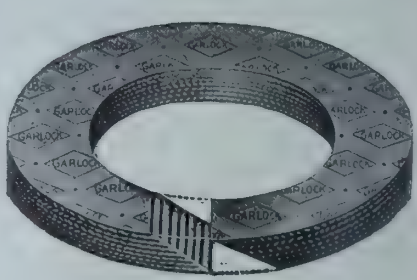
RING AND SPIRAL PACKING

Are You Sure you are using Genuine Garlock Packing, the kind that for years has withstood the trials of the stuffing box?

Do not accept imitations.

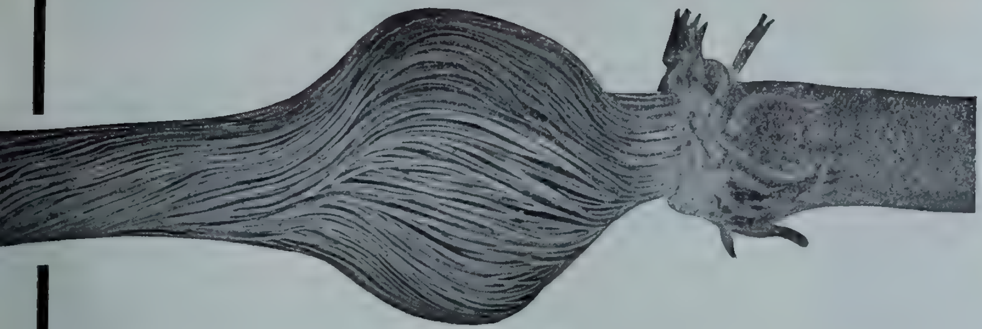
All genuine Garlock Packings are protected by the Garlock trademark.

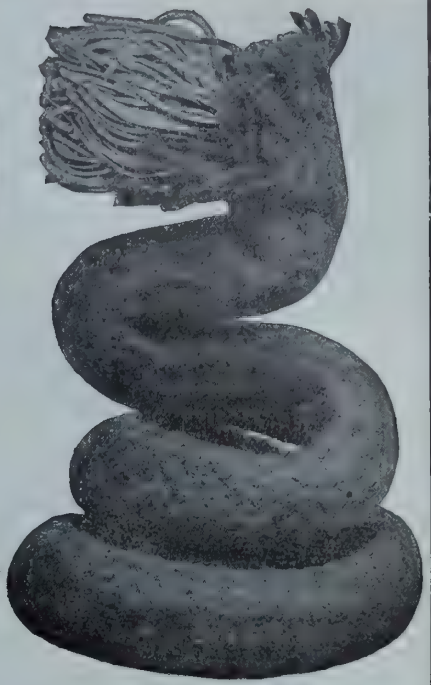
Make sure you have the real thing.



The Garlock Packing Company

Hamilton, Ontario





TRY THIS

Premduro Metallic Packing

ON YOUR SCORED RODS

Soft packing, composed of rubber and canvas, soon loses its original qualities. The canvas next to the rod immediately wears off, exposing the rubber, which is softened by high steam temperature and the rod lubrication. You must expect such packing to prove useless after short service, and you must naturally anticipate trouble.

Solid segmental metallic packing, on the other hand, cannot hold long, for there is not enough elasticity in it and sometimes too much expansion, which is bound to heat the rods. This style of packing is further unsuitable for deeply-scored piston rods working under steady duty and heavy pressure, which, at best, are very severe on any packing.

Premduro Flexible Metallic Packing

will last for years in any engine, pump or refrigerating machine. Premduro Packing contains no rubber, asbestos nor other material that scored rods, high pressure and severe duty can affect.

It is composed essentially of numerous triangular soft metal wires of special composition which will not fuse at any temperature below 625 degrees F. Hence this packing withstands a high degree of superheat. The wires are twisted cable fashion which interlocks them and prevents dislodgement from the rubbing motion of the rod. The wires are packed solidly, but without the rigidity of a solid mass, and are surrounded by a layer of soft knitted covering, the whole being carefully lubricated. In use the covering next to the rod soon wears off, leaving the soft metal to readily shape itself to the scored or smooth surface.

Being of a special composition, Premduro Packing has just the requisite expansion and elasticity to give the rod a perfect-fitting soft metal bearing at all times without creating undue additional heat.

Premduro Metallic Packing is so simple to insert that mallets and packing sticks can be discarded. Just screw up the gland *hand tight,* and when once properly adjusted no further attention will be required.

Premduro Packing is made in 10-foot length of any desired size, or is furnished in rings to fit any box. We stand behind this packing with a positive money-back guarantee. If you are not pleased after a thorough service test you can send the packing back.

Premduro costs less than any other efficient metallic packing. Write for samples, literature and prices.

PREMIER ENGINEERING & MANUFACTURING CO.

25 Broad Street, NEW YORK.

The International Supply Co. of Montreal

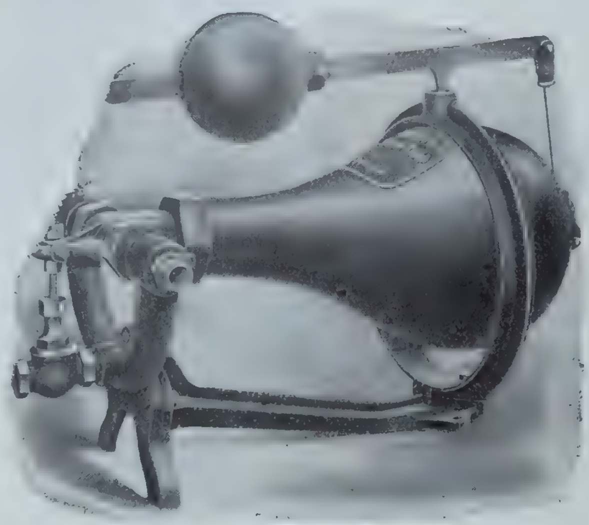
140 Mansfield St. (Phone uptown 1337) Montreal,

Agents for Montreal and Quebec Province, Ontario, British Columbia and Manitoba.

We are open to make agency arrangements with a good manufacturers' agent in each of the big Canadian centres. Liberal proposition to right parties. If interested, write us at once.

The Saving in Fuel Quickly Repays the Cost of

"BUNDY" STEAM TRAPS

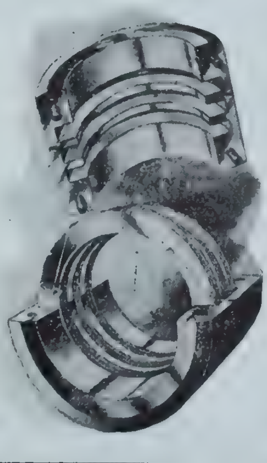


As a rule, the value of fuel saved by its use in one year more than repays the cost of the Bundy Steam Trap.

The best argument in favor of the Bundy—the enormous number now in use are giving absolute satisfaction in every case. Bundy Traps are exceedingly simple and strong in construction. They operate by gravity and stand positively unrivalled in efficiency.

We are prepared to give expert advice for the application of Bundy Traps under any circumstances. Write us to-day for complete catalog and any other information you may require concerning your condensation and boiler feeding problems. We can help you out.

"France" Metallic Packings



are the packings that give the best results under all circumstances. A three-year guarantee accompanies every sale of "France" Metallic Packing; but, as a matter of fact, the average life of "France" Packing, under the severest conditions of service, is seven years. It has been demonstrated hundreds of times that "France" Packings invariably wear as long as the wearing parts of an engine.

Illustrated catalogue sent free on request

Mason Regulators are the Standard

appliances for regulating steam pressures. The accompanying cut shows the Mason Spring Type Fan Regulator. This is the only perfect device for maintaining uniform boiler pressure either in forced or induced draft systems, operating to control the action of steam-driven fan. It is also used for controlling steam jet blowers. We can supply you with the right reducing valve for every purpose.

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PEILER, MACKENZIE & LODGE, MONCTON, N.B.

Also Agents for

ASHTON POP VALVES, RELIEF VALVES AND ASHTON GAUGES FOR ALL SERVICES; REILLY MULTICOIL HEATERS AND SURFACE CONDENSERS; BERRY FEED WATER CONTROL; "P.B.H." GAUGE COCKS AND WATER GAUGES; "TORNADO" FUEL CLEANERS.

CANADIAN ASSOCIATION of STATIONARY ENGINEERS

To the Stationary Engineer who is not a member of the C.A.S.E. :

Can a true, progressive engineer afford to be outside of our organization ?

Remember that we will give methods of improvement to all our members desiring them.

If you are interested in such an association as ours and live where there are less than fifteen engineers located, send for our prospectus and a constitution and apply for admission to the nearest lodge. If you live in a town where there are fifteen or more engineers, get together and send in a written application for a charter.

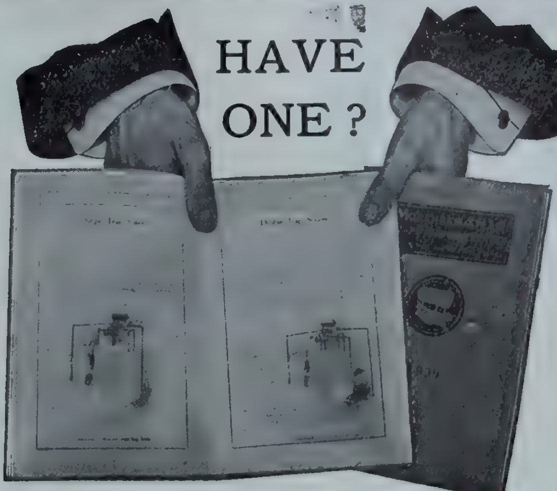
The engineer of to-day, if he is a progressive one, is much interested in securing the passage of laws which compel the engineer to give evidence of his fitness to act as such.

W. A. CROCKETT

Executive Secretary

MT. HAMILTON - ONT.

MOREHEAD



An instructive and valuable book for every user of steam. It is "chuck" full of new ideas on steam and its distribution.

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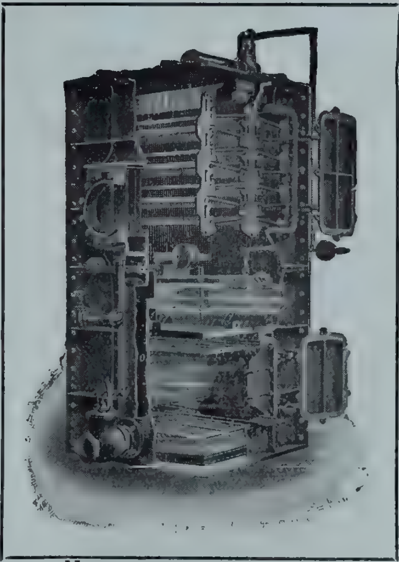
Canadian Representatives—A. R Williams Machinery Co., Toronto; W. H. Markle, Montreal; Park Bros., Chatham, Ontario.

STEAM TRAPS AND BOILER FEED



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Any proposition that will diminish working costs MUST appeal to every shop owner. Have you investigated the

Webster Feedwater Heater, Purifier and Filter?

It makes use of all condensations and waste steam, and will positively rid your boiler of scale by removing scale-forming elements from feedwater. Using pure water means getting every ounce of power out of your boiler, with a SMALLER amount of fuel. Our descriptive literature is full of points for you. Send for it to-day.

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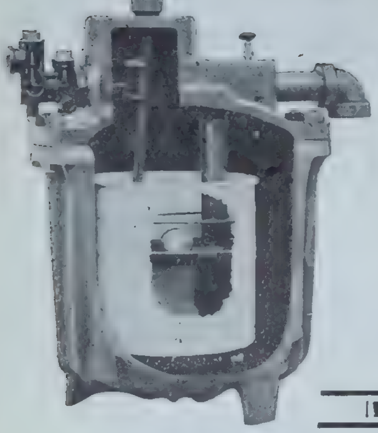


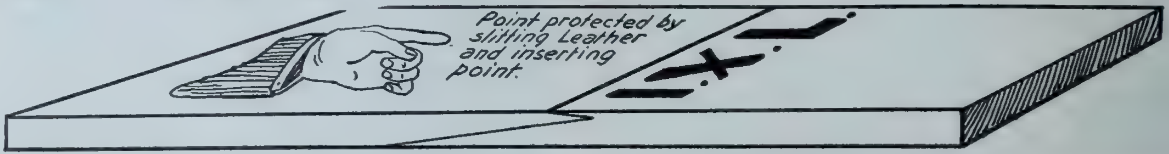
THE ALBANY
STEAM TRAP

Will solve the problem for you. Backed by over 40 years' trap experience. Get in touch with the makers:---

The Albany Steam Trap Co.
ALBANY, N.Y.

THE "I.X.L." SPLICE

"THE BELTING SPLICE THAT WILL NEVER COME OPEN"



The great trouble with *any* belting—no matter how good the leather—that is joined up with the ordinary splice, is the fact that the splices come open, causing loss and delay. J. D. McArthur's Leather Belting made with the "I.X.L." SPLICE, as shown in this cut, *cannot* come open at the splices. Note the protected point, outside point running same direction as pulley.

J. D. McArthur's Leather Belting is made from Prime British Oak-Tanned Leather, from Close-Trimmed Backs exclusively.

Write for our complete price list.

J. D. McARTHUR & CO., Brockville, Ontario

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MAKE YOUR EXHAUST STEAM WOR for you by employing it to heat your Feed Water! This can best be done by passing it through the

JACOBS
Feed Water Heater

the most simple, effective and well constructed apparatus of its kind on the market.

This simple heater will outlast your boilers, and will not bother you with heater troubles.

Fully guaranteed.

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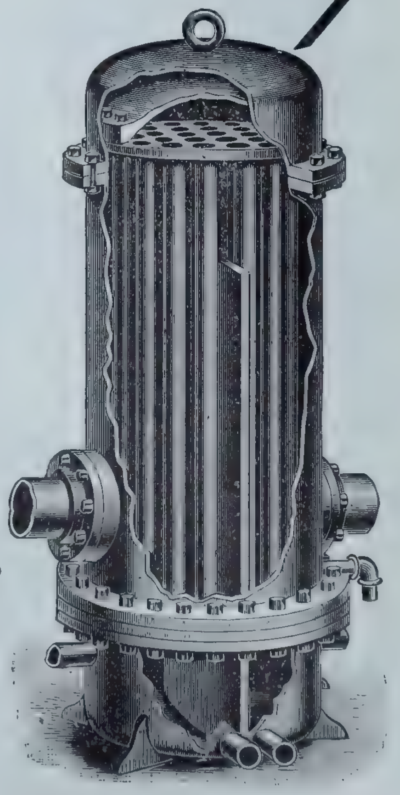

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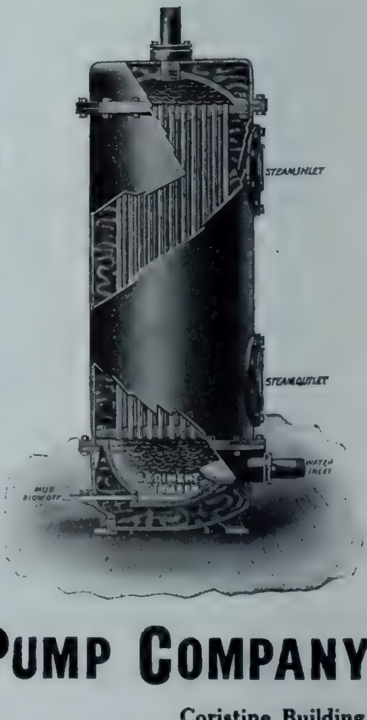
PATENT HEATERS

"Made in Canada"

The tube portion of this heater is not attached to the shell. Allowance for free expansion and contraction makes it the most durable heater on the market.



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The NATIONAL Feed-Water HEATER

Thousands of Horse Power in use in Canada

The reason more National Feed Water Heaters than any other make have been sold in the past 20 years is because they are more practical and efficient.

All joints are brazed and leaking is impossible. From one to fourteen coils of *seamless drawn* brass or copper tubing are encased in a cast iron or steel shell to which *exhaust* steam is admitted, heating the water passing through the tubing.

There is no pressure on the shell at any time and the shell never wears out.

Simplicity is the "key-note" of the "National"; there's nothing to get out of order.

Send for our illustrated catalogue ; it has pointers for every user of power

The National Pipe Bending Co.

91 Lloyd Street
New Haven - - - - Connecticut

Use your exhaust steam

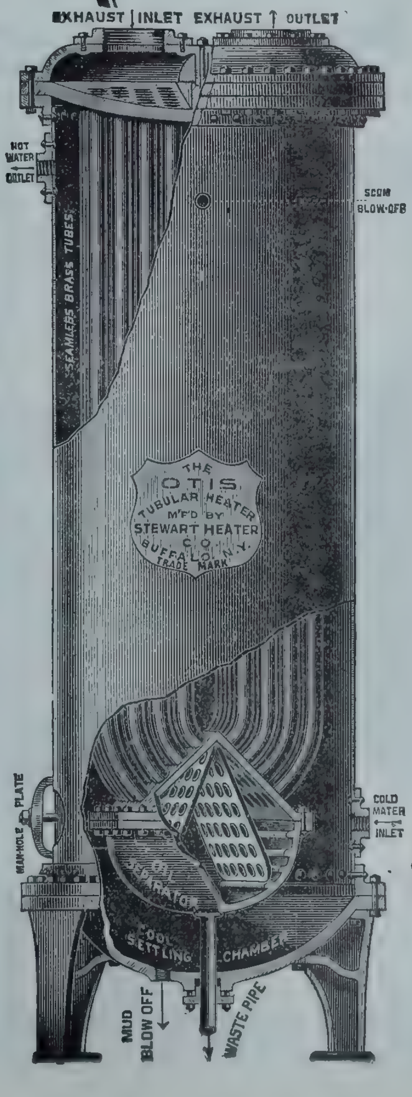
to heat your Feed Water to the boiling point, without any back pressure, by installing an

OTIS

Tubular Feed Water Heater, Oil Separator and Purifier.

By using an "OTIS" the water of condensation can be **returned** from the heating system to the boiler without the additional expense of an eliminator.

The "OTIS" will, moreover, extract the oil from the exhaust, so that the steam, after passing through the heater, may be used for other heating purposes.



We will pay all costs of a trial if the "OTIS" does not "make good."

Write us to-day for catalogue and prices.

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189 Norfolk Avenue
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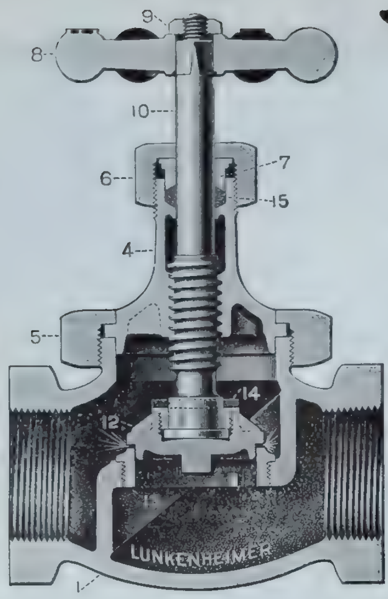

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ARE POSITIVELY THE MOST DURABLE AND PRACTICAL MADE

THE SEATING SURFACES CAN BE RE-GROUND and **ALL PARTS SUBJECTED TO WEAR CAN BE RENEWED**, including the **DISC** and **SEAT**. The **SEAT** is **SELF-CLEANSING** and is made of a hard, close-grained nickel.

The bronze used contains a high percentage of copper and tin. The improved construction of the disc **PRESERVES THE SEATING FACES** and **PREVENTS WATER HAMMER.**

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"Most supply houses sell them—yours CAN—if they DONT or WONT, tell US."

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Largest Manufacturers of high-grade Engineering Specialties in the world

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Kerr Gate Valves

are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

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Genuine "Detroit" Improved Standard Lubricator.

The first "Sight Feed" Lubricator was originated by the Detroit Lubricator Co. over thirty years ago.

To-day we operate the largest plant devoted to the manufacture of Lubricating Devices in the World.

Be sure you get the Genuine "Detroit".

Send for Catalog A58. Illustrating 339 Types-Sizes.

Simple in theory.

All that skill and money can produce in construction.

Dependable in practice.

Every "Detroit" Lubricator is carefully inspected before shipping.

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Independent Unit Filtering Systems

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A postal before you forget it.

WE HAVE

A neat, compact automatic filtering system all on the engine room floor, that will furnish streams of clean, cool oil to all the bearings.

WE HAVEN'T

An overhead tank---a basement reservoir---a steam pump nor any of the connections to these---nor room to tell the interesting story as told in

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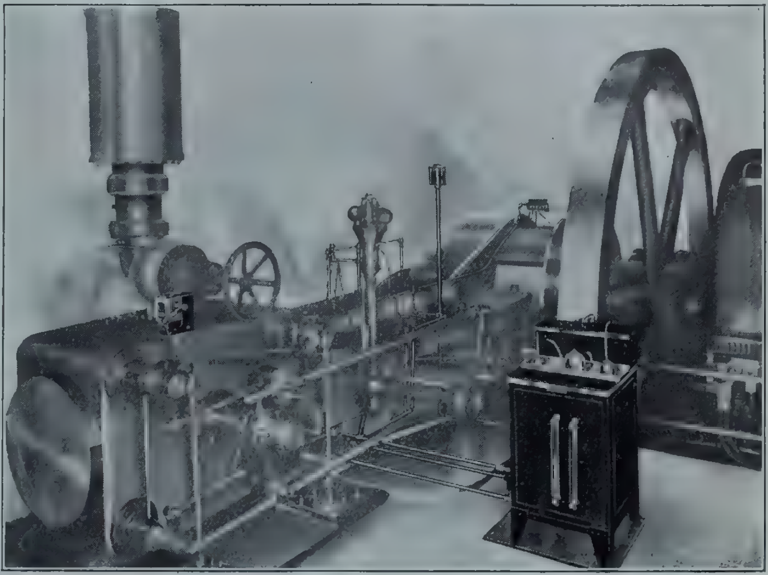
Manufactured by
The
Richardson-Phenix Co.
MILWAUKEE



It's all on the Engine Room Floor.

MICHIGAN

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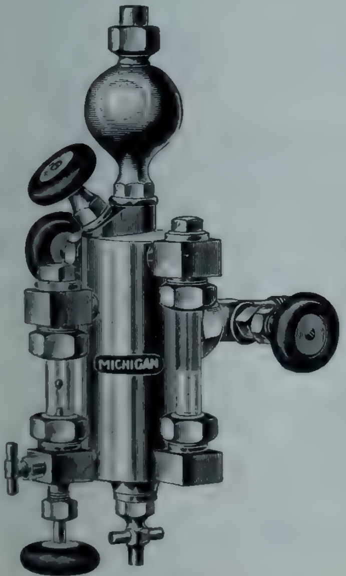
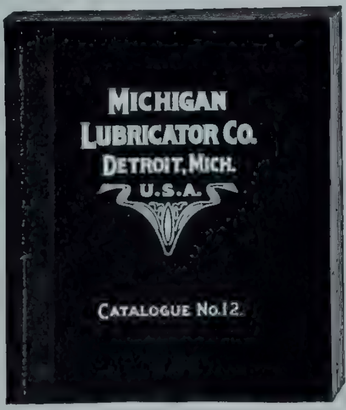
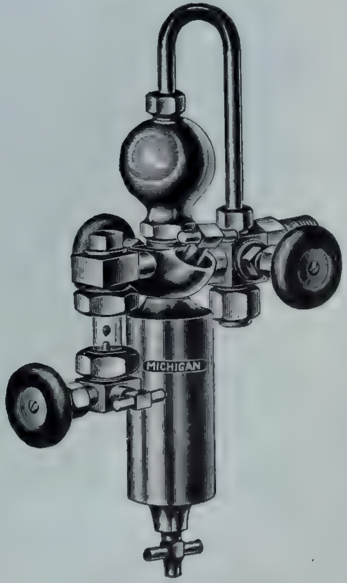


Improved Double Connection,



WRITE TO-DAY



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Leather Belting

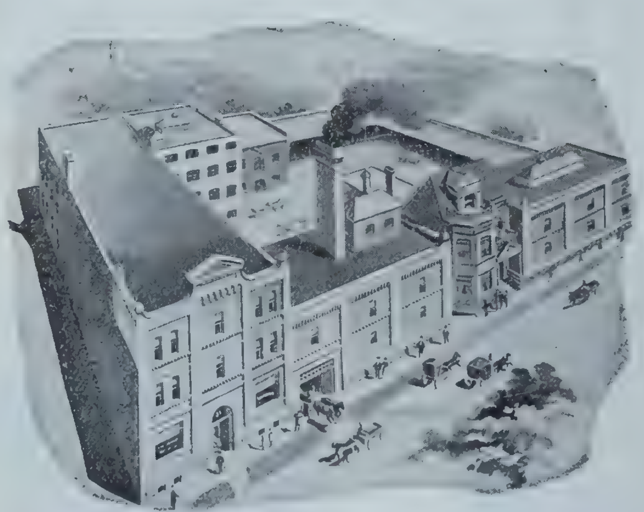
Like a Frog?

BECAUSE it will live and run equally well in wet, sloppy, watery places as on dry land. Remember this when puzzled about a belt for damp, steam laden atmosphere and always specify "AMPHIBIA"

MADE BY

Sadler & Haworth

MONTREAL, 511 William St. TORONTO, 27 Melinda St.
ST. JOHN, N.B., 89 Prince William St. WINNIPEG, 244 Princess St. VANCOUVER, B.C., 217 Columbia Ave.
TO INSURE SATISFACTION—STATE WHERE BELT IS TO RUN



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Babbitt Metal

for all requirements. Tell us YOUR REQUIREMENTS and we will supply metal to suit. Full quality to do the work.

Imperial Genuine for heavy work
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Write for descriptive circular and price list

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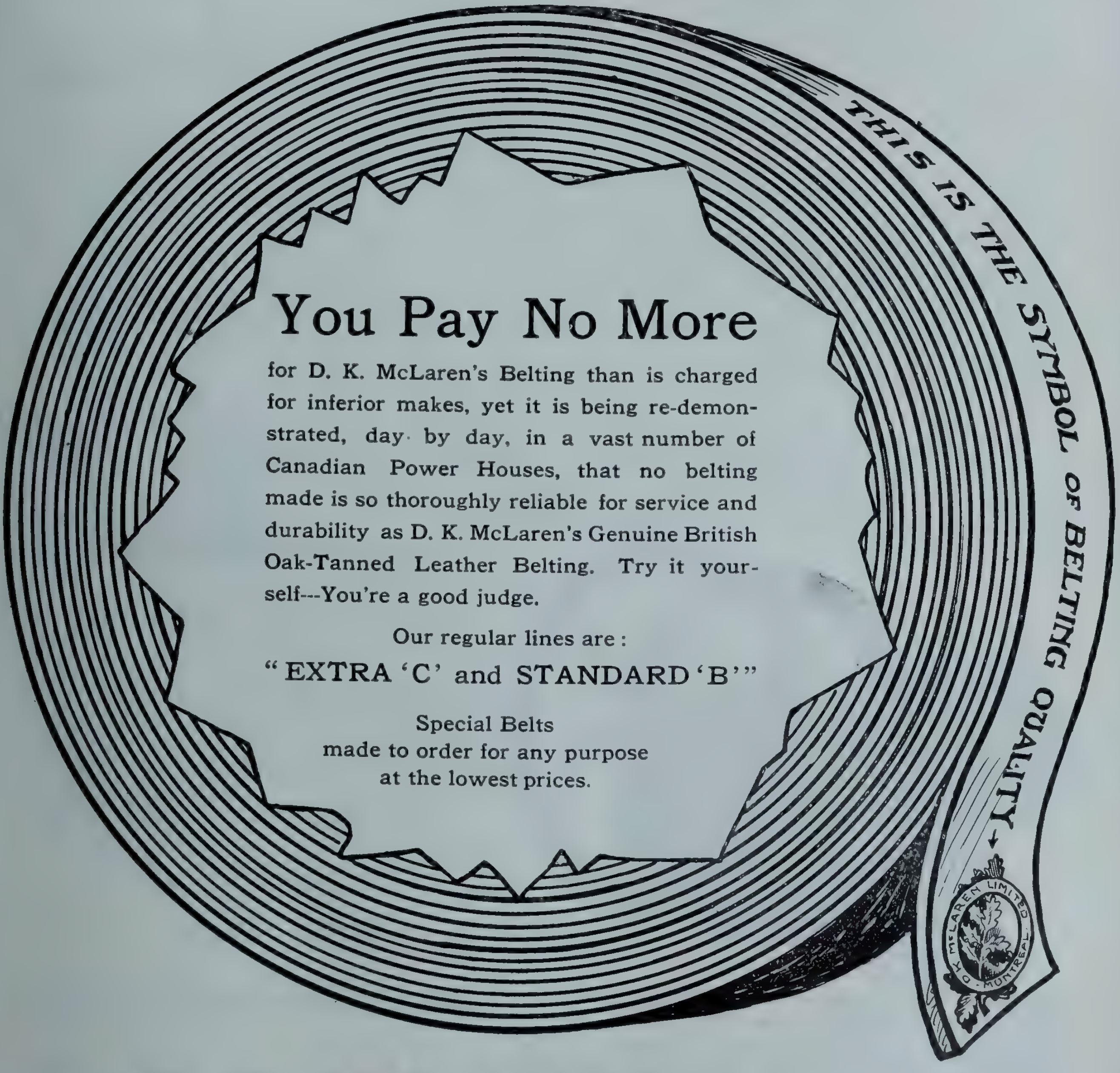
There's long life and satisfactory service in every foot of

D. K. McLAREN'S

Genuine British Oak-Tanned

LEATHER BELTING


THIS IS THE SYMBOL OF BELTING QUALITY
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You Pay No More

for D. K. McLaren's Belting than is charged for inferior makes, yet it is being re-demonstrated, day by day, in a vast number of Canadian Power Houses, that no belting made is so thoroughly reliable for service and durability as D. K. McLaren's Genuine British Oak-Tanned Leather Belting. Try it yourself---You're a good judge.

Our regular lines are:

"EXTRA 'C' and STANDARD 'B'"

Special Belts
made to order for any purpose
at the lowest prices.

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Extraordinary Opportunity!

To Purchase a High Grade Gas Engine at Wholesale Prices

400 FAIRBANKS-MORSE ENGINES TO BE SOLD AT ONCE

The Reason---

We have had manufactured and have ready for delivery in anticipation of this year's Grain Elevator business in the West,

100— 5 Horse-power Engines.
150— 8 do.
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50—12 do.

Owing to the drought there will be little elevator building, and rather than carry them over another year, we will sell them at great reduction, as long as they last, as we haven't room to carry them.

Fairbanks-Morse Gas Engines are used all over the world. EIGHTY THOUSAND engines have been sold up to date. The engines are the result of years of experience on all problems connected with Gas Engine Practice. No company in the world has spent as much money as Fairbanks-Morse & Co. on experimental and development work in connection with every type of Gas Engines.

The many thousand in use to-day stand as a guarantee of the absolute correctness of the principles involved, the high class of workmanship, careful selection of materials and the reliable and efficient service rendered by the finished machine.

A record like this is based solely upon recognized merit.

The Engine and Your Opportunity

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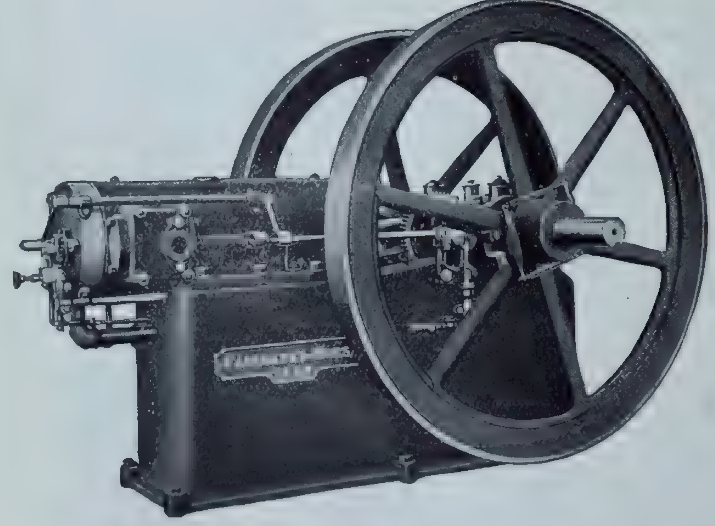

Standard Fairbanks-Morse Horizontal Engine, complete with Fuel and Cooling Tank. Sizes—5, 8, 10, 12 H.P.

The Canadian Fairbanks Co., Limited
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Please send me prices and complete information on your Special Offer of 400 Standard Fairbanks-Morse Gasoline Engines. State size required.

Name . . . .

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Fairbanks Scales—Fairbanks-Morse Gas Engines
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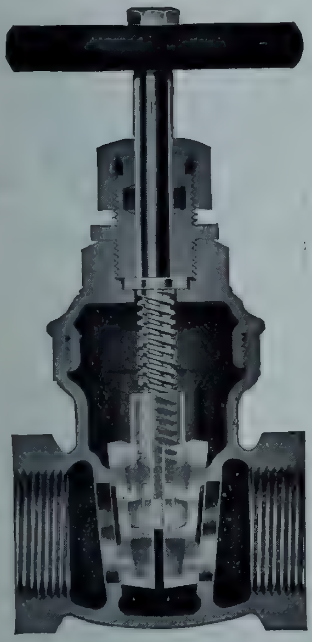
That's all you need to know about a Valve. It insures the best in

QUALITY

and

DESIGN

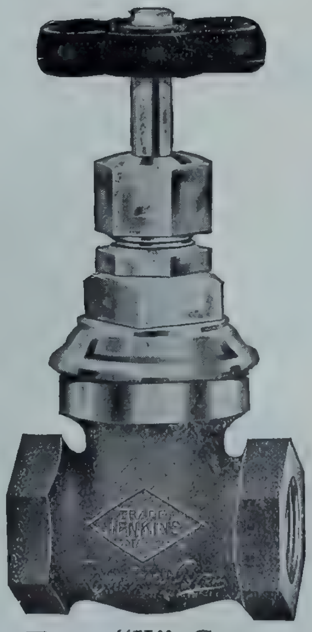


Section Type "K" Gate Valve.
One of our latest models

Years of experience, skilled workmanship and perfectly equipped factory combine to make us among the foremost manufacturers of Valves in the world.

Did you see our exhibit at the C.A.S.E. CONVENTION, Berlin, Ont., this month? It was the centre of attraction for many.

Any time you are in Montreal call and see us. We will make you welcome.



Type "K" Gate Valve
Outside View

JENKINS BROS. LIMITED

102 St. Remi Street, : : MONTREAL

The construction of

Dart Unions

at once appeals to the practical engineer.

Examine these cuts and observe the ball-shaped ground seat, which is bronze on each face of the joint. This feature of DART construction prevents corrosion, and enables a perfectly tight joint to be made quickly, either in or out of line, time after time.

DART Unions are made to exact standards, with long, clean threads and extra heavy iron ends that give unusual durability. The installation of Dart Unions throughout your plant will stop all loss at joints, and effect an important saving in repairs.

Sold by all dealers

Dart Union Co., Limited
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We want you to prove Dart lines in your own plant

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Would you like one of these Pocket Steel Tapes

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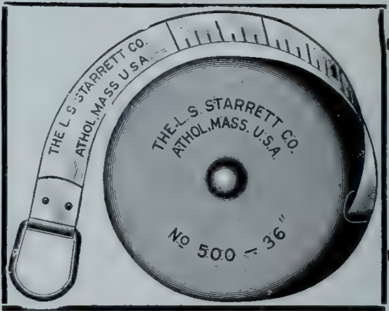
You can easily earn one without spending a cent!


THE L. S. STARRETT CO. ATHOL, MASS. U.S.A.
THE L. S. STARRETT CO. ATHOL, MASS. U.S.A.
No 500 — 36"

If you are a subscriber to *"The Power House,"* send us along two new subscribers at one dollar each, and the Tape is yours.

If not, send along your own subscription and two others.

"Simple and easy," you'll say! In fact, a recommendation of the value of *"The Power House"* to every Canadian engineer, superintendent and power user is generally sufficient for him to part with his dollar.

"The Power House" is a necessity to every wideawake engineer, because it contains all the latest and best information in the engineering field.

This handy Tape is of first-class workmanship, 1¼ inches wide, with rounded corners. The Tape itself is ¼-inch wide, accurately marked in inches and sixteenths, and is 60 inches long. Value 75c each.

Get Busy To-day
Published Monthly at $1.00 a year

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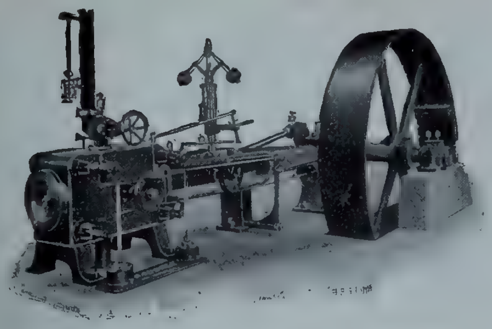

Girder Bed Corliss Engine

Catalog on application

ESTABLISHED 1867

The VILTER MFG. CO.

242 Becher Street Milwaukee, Wis., U.S.A.

BUILDERS OF HIGH-GRADE

CORLISS ENGINES

Simple or Compound, Girder or Heavy Duty Bed. Any size, 30 to 1,000 H.P.

Ice and Refrigerating Machinery

THE LINDE {AMMONIA and CARBONIC ACID} SYSTEMS

For Cold Storage and Ice Making Plants

Patent Seamless CORK INSULATION—Efficiency With Economy

Send for our catalogue showing details of installations and containing many useful tables and other data concerning this industry.

The Linde British Refrigeration Co., Limited - Montreal

COMPLETE PLANTS DESIGNED AND INSTALLED

Has Cost Nothing for Repairs

A customer says:—

"We have used one of your vertical high speed engines, English type, forced lubrication, since 1907. The engine runs at 425 revolutions per minute almost constantly night and day. It has given us every satisfaction and so far has cost us nothing for repairs."

Robb Engineering Co., Ltd., Amherst, N.S.

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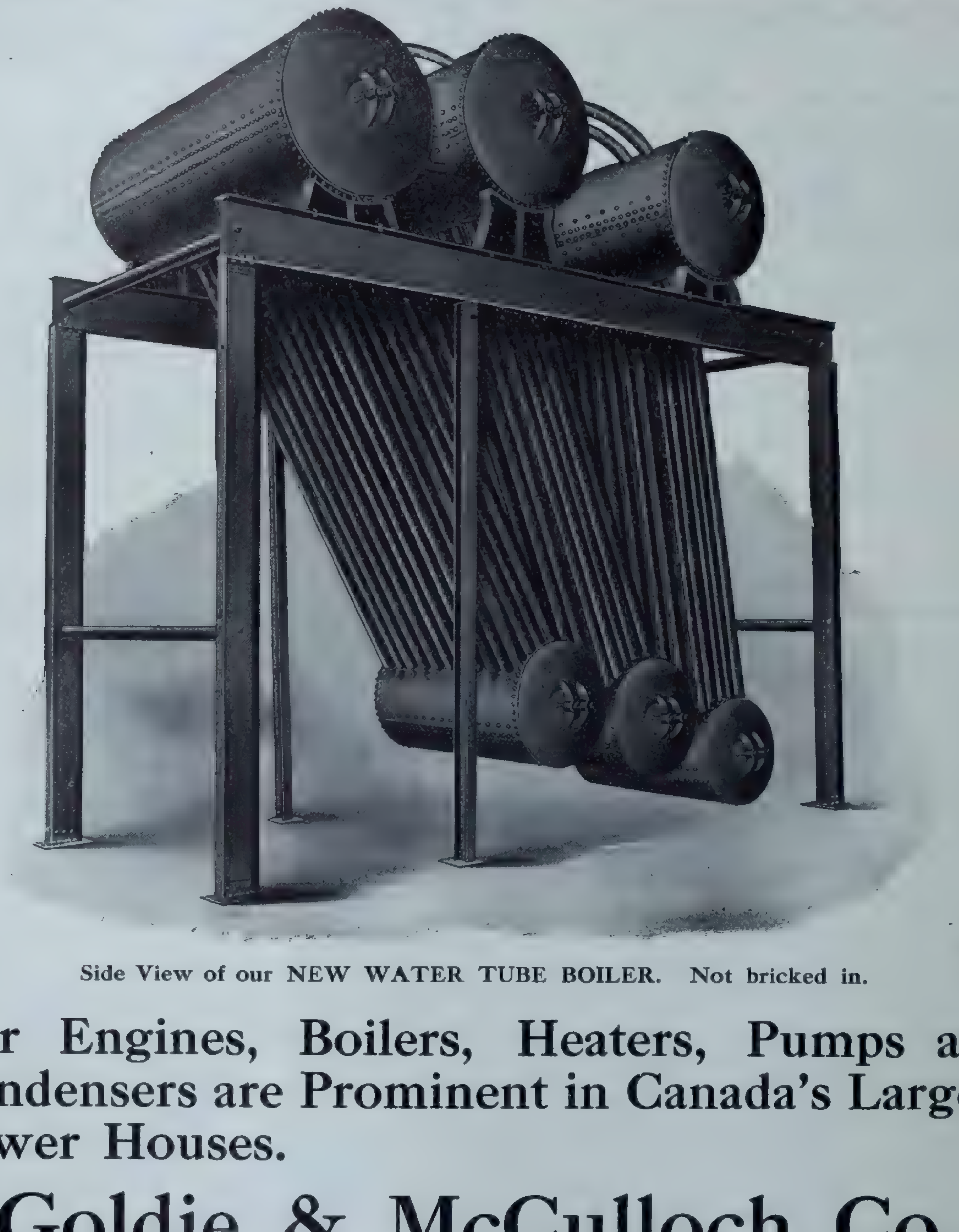
Water Tube Boilers

Return Tubular, Horizontal Marine, Vertical and Portable Boilers, with or without Wheels



Side View of our NEW WATER TUBE BOILER. Not bricked in.

Our Engines, Boilers, Heaters, Pumps and Condensers are Prominent in Canada's Largest Power Houses.

The Goldie & McCulloch Co., Ltd.

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WESTERN BRANCH	QUEBEC AGENTS	BRITISH COLUMBIA AGENTS
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WE MAKE Wheelock Engines, Corliss Engines, Ideal Engines, Piston Valve Saw Mill Engines, Gas Engines and Producers, Boilers, Heaters, Steam and Power Pumps, Condensers, Flour Mill Machinery, Oatmeal Mill Machinery, Wood-Working Machinery, Transmission and Elevating Machinery, Safes, Vaults and Vault Doors.

Ask for Catalogues, Prices and All Information.

A Group of Engineers, Exhibitors and Friends at the Pavilion, Victoria Park, Berlin.

The Twenty-First Stationary Engineers Convention

The Annual Convention of the Canadian Association of Stationary Engineers, Held at Berlin July 26, 27 and 28, was a Big Success

THE coming of age convention of the Canadian Association of Stationary Engineers was marked by several interesting features which should, and no doubt will, become permanent features of future conventions. The most prominent of these was the Wednesday evening meeting when papers of interest to both engineers and their employers were read by authorities. That they were appreciated was shown by the large number in addition to the delegates who listened to their presentation by the authors.

The reading of papers was the result of a happy thought on the part of the exhibition at the 1909 convention. A committee was appointed to interview the C.A.S.E. executive and an evening was set apart for educational purposes. The success justifies this being made permanent. A perusal of the papers which are reproduced in this issue should convince every engineer of the value of attending the convention whether a delegate or not.

Another thing which assisted in making the convention a success was the publicity given to the exhibition of power equipments and supplies. The supplymen at considerable expense, showed the developments of modern practice and that it was appreciated was shown by the large number of interested engineers and manufacturers who examined the various displays.

Tuesday.

There was a grand opening at 11.30 A.M. at which civic representatives, visitors and ladies were present. E. C. Fitzgerald introduced the Mayor. He said he was always glad to be able to put his shoulder to the wheel to make the convention a success. In his remarks he said that Berlin lodge had spared no efforts, so that both pleasure and profit might be the result.

Mr. Hahn, the Mayor, welcomed the C. A. S. E. in a well chosen address:

"It affords me great pleasure to welcome you to Berlin. Berlin is unique in many respects. We own our own municipal utilities. The Niagara Union Power started here. The coming of the Hydro-Electric will be celebrated in a few weeks. We have the finest Educational Institution in this section of country. Berlin is a town of working men who own their own homes which are the finest in Canada. As President of the Trades and Labor council here, anything I can do to assist you I shall be glad to do it. It affords me great pleasure to offer to you the freedom of Berlin."

W. A. Crockett, Secretary of the C.A.S.E. made mention that owing to the lack of proper railway facilities, as many as were expected could not be present. This is the third visit to Berlin, he said, and of what he has seen, he was quite positive that Berlin is one of the finest cities in this part of Canada. He referred to the homes of the Berlin laborers and complimented them on the neat condition in which they are kept.

A. M. Wickens in reply thanked the Mayor for his kindness and hoped to be able to come back to Berlin ere many years had passed. We have learned a great deal since last we were here and trust to know more by the time we again come back.

E. J. Phillips in a speech of welcome, said in part: "As a resident of Berlin and as a member of the C. A. S. E. I must say that I have had many pleasant recollections in Berlin. Indeed, I am so fond of Berlin that to me there is nothing like it on earth. I have traveled from shore to shore and north and south and am thus in a position to know. Our working men have good houses. We have many good brick houses and well kept lawns and good live citizens.

Chas. Kelly, the genial president of the executive also replied, and was pleased to hear the Mayor say that the freedom of the city had been granted to the delegates. He thanked the Mayor for this courtesy, and said that he did not expect that anything would take place to mar the good feeling which existed. So far, he was well pleased with what he had seen of Berlin and trusted that much good might ensue from the deliberations of the delegates assembled.

Stratford's Congratulations.

A telegram was received from Stratford expressing heartiest congratulations on twenty-first annual convention of the C. A. S. E. It was signed by Alex. Scrimgeour, President.

It was moved by Bro. Campbell, seconded by Bro. Norris, that a reply be sent by telegram. Carried.

Bro. C. Kelly, Chatham Executive President, was in the chair. The following executive officers were also present:

Past President, W. C. McGhie, Toronto; J. J. Heeg, Guelph, Vice-President; A. M. Wickens, Treasurer, Toronto; W. Norris, London, Conductor, and W. Maedel, Windsor, Door-Keeper; W. A. Crocket, Mount Hamilton, Secretary. After the reception ceremonies, the president named the committee on credentials: Bros. W. A. Crockett, Hamilton; A. M. Wickens, Toronto and D. F. Campbell, London.

Auditors: Bros. Kastella, Stratford; W. E. Archer, Toronto and H. R. Clark, Hamilton.

Striking and Standing committee: Bros. Robertson, Stratford; H. J. Wickens, Brampton; W. Prout, Chatham; C. Moseley, Toronto; and F. Smith, Windsor.

The meeting then adjourned to meet at 2 o'clock P.M.

Tuesday Afternoon.

The credential committee reported their credential cards had been duly filed. Moved by Bro. H. R. Clark, seconded by Bro. W. F. Lamberton, that the report of the credential committee be received. Carried.

The following committees were elected:

Ways and Means committee: H. J. Wickens, Brampton; G. J. Scott, Ottawa; C. J. Peppin, Belleville; W. E. Archer, Toronto; P. Uttely, Berlin.

Good of the Order committee: Bros. H. E. Terry, Toronto; H. R. Clark, Hamilton; W. J. Wilkinson, North Bay; D. F. Campbell, London; J. A. Robertson, Stratford.

Mileage and Per Diem committee: Bros. J. B. Forsyth, Brantford; W. Galloway, London; E. Crocker, St. Thomas; E. C. White, Arnprior; W. Prout, Chatham.

Moved by Bro. G. F. Galloway, seconded by H. R. Clark, That the report of the striking committee be accepted. Carried.

The minutes of the last convention held in London in 1909 were read from the report which appeared in "The Power-House" and which was the official report of Secretary Crockett. This was done on account of the clearness of the printing, the typewritten copy being attached to the minute book. Exception was taken to this method of presenting the minutes to the convention. After some discussion the minutes were adopted.

Moved by Bro. Norris, seconded by H. J. Wickens, that a reply be sent to the telegram received from Stratford and signed by Bros. Kelly and Crockett. Carried.

President Kelly's Report.

Berlin, July 27th, 1910.

To the officers and delegates assembled in convention:—

Gentlemen and Brothers:—

It is with pleasure that I am able to report to you for the second time on the progress of our society. I desire to thank you for the honor you conferred upon me in electing me to a second term and I can assure you it is fully appreciated by me. I have endeavored to do what was for the best interest of our Association and trust that I have been fairly successful. I have visited Windsor and Wallaceburg and am pleased to state that we were successful in getting a lodge started there. In Windsor I found that some work was needed to smooth the kinks out. That was done and things are again working well. Our financial condition is in good shape and augurs well for the future.

1. I would recommend that a bureau be started for the purpose of keeping in touch with the manufacturers and that all our members be instructed to send their names and addresses to the Secretary when requiring position. That a card be printed adequate for the above purpose.

2. That as soon as possible a suitable member be instructed and empowered to visit localities where it is deemed expedient to institute new lodges.

3. That a prospectus be printed and distributed for a moderate price, same to combine all the latest ideas and formulas in Steam, Electrical and Gas Engineering.

4. That manufacturers be asked to advertise in the above according to the best judgment of the committee on Good of the Order.—Yours fraternally, Chas. Kelly, Ex.-President.

Secretary's Report.

Berlin, Ont., July 26th, 1910.

Gentlemen and Brothers,—It is a pleasure to be able to be with you once more and have the honor of submitting a report on the proceedings of the 21st annual convention of the C. A. S. E. Executive. There have been very many inquiries from isolated plants in different parts of the Dominion and many were desirous of joining our ranks but on account of the long distance between places it was not deemed desirable to accept them as members. They were, however, referred to the nearest lodge.

We have added two new lodges during the new year, Arnprior and Wallaceburg, and our thanks are due to Bro. Kelly and J. J. Jack, for the interest taken by them.

Several complaints have been received re the working of the Stationary Engineers' Act and much dissatisfaction has been expressed.

I am pleased to see that a better spirit of harmony exists between other locals and ourselves and I trust that the time is not far distant when that spirit will bring about results beneficial to all concerned. I again recommend the Committee on the Good of the Order, to extend the work along the line of last year's report.

The financial report is as follows. Yours fraternally, W. A. Crockett.

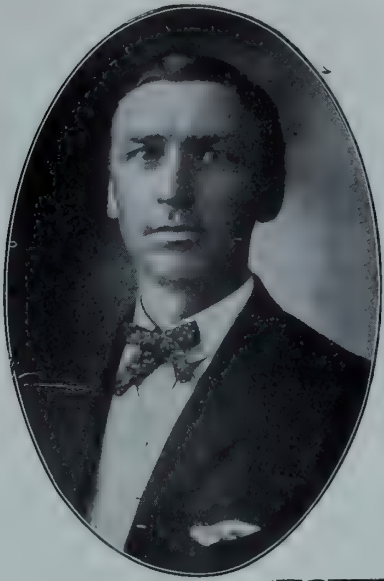
Treasurer's Report

Cash received, Secretary......		452.88
Cash paid, sec.'s ac't	44.51	
Cash paid Treas.......	175.00	
Cash in bank, sec. ..	233.37	
		452.88
Cash received	452.88	
Cash rec'd, Treas Tor. No. 1	45.00	
Toronto No. 1, sub. ..	9.00	
Toronto, No. 1 per ct.	43.50	
Cash on hand	339.18	
Interest Treas.	7.18	
		896.74
Cash in bank, S......	233.37	
Cash in bank, T.	173.73	
Cash on hand, T.	9.06	
		416.16
Cash paid, S.	361.41	
Cash paid, T.	119.15	
Diff.	.02	
		480.58
		896.74

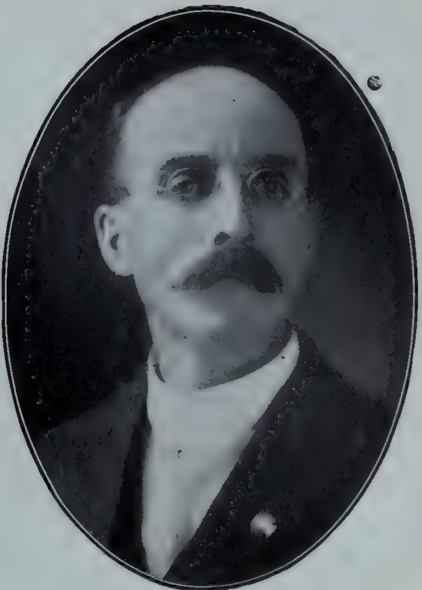
1909.	Receipts	
July 1	Cash in bank	$116.46
July 1	Tor. No. 1 per cap..	45.00
July 28	From Secretary	222.70
July 29	Form Secretary	150.00
July 29	From Secretary	25.00
1910.		
Jan. 20	Toronto No. 1 supplies	9.00
Mar. 15	Toronto per cap.	43.50
June 30	Interest	7.18
	Total	618.84
1909.	Disbursements.	
July 29	Milage and per Diem	281.90
July 29	Honorium for Sec. ..	25.00
July 29	Honorium for Treas. .	10.00
July 29	A. W. Smith & Partners, advt. to July ..	20.00
July 29	Printing Rituals	15.50
July 29	Discount on check ...	.15
1910.		
Feb. 21	Ambrose Kent, two jewels	31.00
May 2	Ambrose Kent, buttons	35.00
June 11	A. W. Smith & Partners, advt.	17.50
June 30	Cash in bank	173.73
June 30	Cash on hand	9.06
	Total	$618.84

Yours fraternally, A. M. Wickens.

CHAS. KELLY, CHATHAM,
Past President C.A.S.E.



J. J. HEEG, GUELPH,
Executive President, C.A.S.E.



WM. NORRIS, CHATHAM
Executive Vice-President.

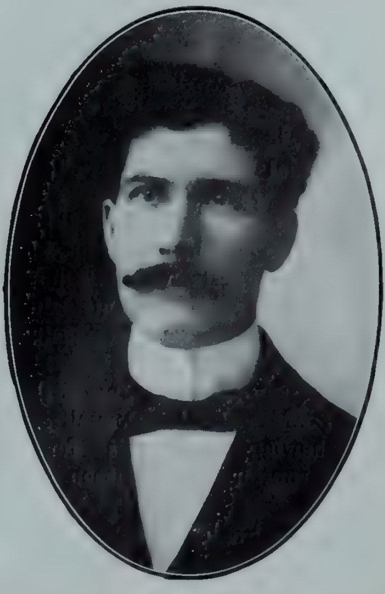
A. M. WICKENS, TORONTO,
Executive Treasurer C.A.S.E.

H. R. CLARK, HAMILTON,
Executive Doorkeeper, C.A.S.E.

W. A. CROCKETT, MT. HAMILTON,
Executive Secretary C.A.S.E.

E. C. FITZGERALD,
Chairman Berlin Convention Committee.

W. C. McGHIE,
Chief of Ontario Stationary Engineers' Examining Board.



J. A. ROBERTSON, STRATFORD,
Executive Conductor, C.A.S.E.

Moved by Bro. H. R. Clark, seconded by H. J. Wickens, that the President's report be received and handed over to the Committee on Good of the Order. Carried.

Report of Secretary. Moved by Bro. Terry, seconded by Bro. C. Moseley, that this report be received and handed to the Audit Committee. Carried.

Moved by Bro. H. R. Clark, seconded by Bro. Kastella, that the report of the Treasurer be received and handed to the Audit Committee. Carried.

The following communication was received. Mr. Hetherington, of the Goldie & McCullough Co., wishes to take the delegates to Preston to show them the engines at the street railway. He will get a special car for the delegates.

In re ritual. It was decided that the matter of changing the ritual with suggestion of installation ceremony be handed to special committee. The President named the credential committee for this purpose.

Moved by Bro. D. F. Campbell, seconded by H. J. Wickens, that Bros. Gonyou and Bucke be added to the credential committee. Carried.

With respect to the Ladies' Auxiliary it was decided that nothing could be done until all the papers and books are produced. It was suggested by Bro. Moseley that we write to the N.A.S.E. Ladies' Auxiliary for information as to their working.

With respect to the first clause contained in the President's report after a lengthy discussion in which the following Bros. took part, Bros. A. M. Wickens, H. E. Terry, H. J. Wickens, C. Moseley, J. Scott, W. Norris, J. Kastella, J. J. Heeg. It was moved by Bro. H. J. Wickens, seconded by Bro. Kastella that this matter be laid over until after the report of the Ways and Means Committee. Carried.

Moved by Bro. J. J. Heeg, seconded by Bro. C. Moseley, that we do now adjourn till nine o'clock Wednesday morning. Carried.

The annual banquet was held Tuesday evening, when the Berlin lodge entertained the C.A.S.E. and Exhibitors' Association to a dinner, in the Walker House. The guests were then entertained at the theatre, this entertainment taking the place of the customary speeches.

Wednesday Morning, July 27th.

Report of Credential Committee was given showing credentials for Bros. Whyte, Arnprior, J. Thomson, Owen Sound.

Moved by Bro. C. Moseley, seconded by Bro. H. R. Clark, that the report be received. Carried.

Report of the Committee on the Good of the Order.

Moved by Bro. Terry, seconded by Bro. C. Moseley, that report of the Committee on the Good of the Order, be received and discussed clause by clause. Carried.

Good of the Order.

Berlin, July 26th, 1910.

Mr. President:—

C. A. S. E.

Your committee on Good of the Order beg to recommend as follows:

1. We approve the President's recommendations, re Employment Bureau, which recommendation is as follows: That a bureau be started for the purpose of keeping in touch with the Manufacturers, and that all our members be instructed to send their names and addresses to the Secretary when requiring situations.

2. We approve the President's second recommendation providing that a suitable member be sent from the nearest lodge to the instituting point. The Executive to provide the funds. The recommendation was as follows: That as soon as possible a suitable member be instructed and empowered to visit localities when it is deemed expedient to institute new lodges.

3. That no action be taken by this convention re the publishing of an enneer's hand-book.

4. We strongly recommend that the present Preamble to the Constitution remain exactly as it is.

5. We your committee respectfully recommend that a new minute book be procured by the Executive and that the minutes of each convention be written out in said book and signed by the secretary and when confirmed, signed by the President. All of which is respectfully submitted.

H. E. Terry, Chairman, D. F. Campbell, secretary, W. J. Wilkinson, J. A. Robertson, H. R. Clark.

1st clause. Moved by Bro. H. E. Terry, seconded by Bro. D. F. Campbell, that this clause be adopted. Carried.

2nd clause. Moved by Bro. H. E. Terry, seconded by W. J. Wilkinson, that this clause be adopted. Carried.

3rd clause. Moved by Bro. C. Moseley, seconded by Bro. W. E. Archer, that this clause be referred back to the Committee of the Good of the Order. Carried.

4th clause. Moved by Bro. H. E. Terry, seconded by Bro. W. J. Wilkinson, that this clause be adopted. Carried.

5th clause. Moved by Bro. C. Moseley, seconded by Bro. H. E. Terry, that this clause be adopted. Carried.

Moved by Bro. J. A. Robertson, seconded by Bro. C. Peppin that report be received as Interim report. Carried.

Report of Ways and Means.

1. This committee recommends that Article 4, Sec. 2, be amended as follows: Before any member of the Executive Council can be eligible for the office of the Executive President, he must pass through the chairs of Door-keeper, Conductor, and Vice-President.

2. This committee recommends that Article 2 of Sub Association be amended as follows: "The objects of this Association shall be for the education and elevation of its members, etc."

3. Toronto No. 1 recommendation, re Executive Board be concurred in, with the addition of the following rider: That any member of Board not in attendance one day before convention without sending representative or good and sufficient reason for absence, will be summarily dismissed.

4. That committee be elected by majority vote of Executive body. All of which is respectfully submitted.

H. J. Wickens, G. J. Scott, C. J. Peppin, W. E. Archer, P. Uttely.

Clause 1. Moved by Bro. W. E. Archer, seconded by Bro. C. J. Peppin, that we recommend the adoption of clause 1 of our report.

Moved in amendment by Bro. H. E. Terry, seconded by Bro. W. J. Wilkinson, that no brother shall be elegible to the office of President of this council, who is not a Past President or President of a subordinate Association and shall have held one elective office in the Executive. Carried.

Moved by Bro. W. E. Archer, seconded by Bro. C. Moseley, that clause 2 of the Ways and Means report be adopted as amended by the committee. Lost.

Clause 4. Moved by Bro. W. E. Archer, seconded by Bro. C. Moseley, that clause 3 be concurred in with addition of clause 4.

Moved in amendment by Bro. J. A. Robertson, seconded by Bro. W. Maedel, that the above be left over for one year, subordinate lodges notified and plebescite taken. Carried.

Wednesday Afternoon.

On Wednesday afternoon the C.A.S.E. delegates and their friends participated in a programme of sports which was pulled off at Victoria park and everybody had loads of fun. This was the Exhibitors' treat and the prizes and supper were supplied by them. The programme was varied and gave everybody a chance to "steam up." The program, winners and prizes were as follows:—

Three-Inning Ball Game.—Engineers vs. Exhibitors. Balls and bats furnished by exhibitors. All mits and catching gloves prohibited. 45 feet between bases. Game umpired by G. C. Keith.

Won by Engineers in exciting game, 9-8. No prize.

The alleged ball players on the two teams were:

Engineers (9)		Exhibitors (8)
Thompson	P	Hetherington.
Heeg	C.	Woodward.
Galloway	1 b.	Goff.
Kastella	2b.	Meyers.
Hett	3b	Tyrrell
Batcher	s.s.	Fisher.
Grandbois	l.f.	McKinnon.
Archer	r.f.	Phillips.
Lamberton	c.f.	Kelleher

Relay Race.—Four man team. Distance between points, 50 yds. J. Heeg, Campbell, Galloway, Hett. Prize, 4 toy horns. This constitutes the official C. A. S. E. band.

Ladies' Race.—25 yds. straight away. All ladies eligible, spiked shoes prohibited. Mrs. Fletcher. Prize, Egg beater.

Donkey Race.—25 yards return.

This race was run in teams of two, one carrying the other on his back to the pole, then changing places and returning. Hett, Galloway. Prize, 2 toy jackasses.

Cigar Race.—Men only, no boys allowed. 50 yds. run. The object being to light the cigar and reach the goal first. Wm. Prout. Prize, Ash tray. Child in bath tub.

Potato Race.—Ladies only. Six potatoes to be gathered one at a time on a spoon and return to goal. Miss Crockett, Mirror with inscription, "How you look."

Barrow Race.—All eligible. 25 yds. and return. Two men to a team, changing places at the return poles. Hett, Galloway. Prize, 2 toy wheel barrows.

Number Race.—Ladies and Gentlemen partners, 50 yards and return. Ladies one end and gents the other. Men run to lady and find the corresponding number and return with lady. Duncan Medcalf, Mrs. Walters. Prize, 2 baby dolls.

Fat Man's Race.—50 yds. straight away. Waist measure not less than 40 inches and not over 50 inches. Chas. Morley. Prize, Billiken man.

Shoe Race, 25 yards straight away—J. A. Robertson. Prize, jumping-jack.

Boxing Tournament — Contestants furnished with soft gloves and required to stand in a barrel. The opponent defeated as soon as he loses his position. J. J. Heeg, of Guelph, put Ed. Philip out of business; C. Mosely, of Toronto, cleaned up V. O. Phillips; Buck lost to Robinson; J. B. Goff won from D. O. McKinnon; D. M. Medcalf from H. E. Terry, and A. Kastella got the decision over W. A. Crockett. The winners in each round received cute little Jack Johnson colored kids. J. J. Heeg, the final winner, was presented with the boxing gloves.

The officials were: Starter, George Fisher, London; official referee, J. N. Gregory; boxing referee, Jack Armour. The chief instigator of the sports was John B. Goff, and the prizes were handed to the winners by D. O. McKinnon and G. C. Keith.

The Evening Smoker.

There was a big attendance at the evening meeting, presided over by W. A. Crockett, of Mt. Hamilton. A. K. Spotton, of Goldie & McCulloch firm, of Galt, read a paper on "The Considerations Affecting the Choice of an Engine."

"Steam as a Motive Power" was the subject of a paper read by A. M. Wickens, of Toronto. H. L. Peiler, of Montreal, spoke on "The Saving of Heat Units." He showed how great savings can be made by watching the little things, and where losses can be made into gains.

During the evening, the exhibitors supplied good smokes for all.

Thursday Morning, 9 a.m.

Report of mileage and per diem committee. Moved by Bro. J. Thompson, seconded by Bro. Bucke, that report be received and accepted.—Carried.

Report of Ways and Means Committee.

Clause 3 of W. and M. Moved by W. E. Archer, seconded by C. J. Peppin, that clause 3 be adopted.

Moved in amendment by H. J. Wickens, seconded by Bro. W. Prout, that this be laid over for another year for further information; that the old committee be discharged and a new one be appointed, and detailed report be presented next year.—Carried.

Moved by Bro. W. E. Archer, seconded by Bro. C. Moseley, that we have biannual conventions.

Moved in amendment by Bro. W. Norris, seconded by Bro. J. J. Heeg, that this matter be left to the executive to take up with subordinate lodges; have plebescite vote taken and then the executive to decide upon the result.—Carried.

Moved by Bro. W. E. Archer, seconded by Bro. C. Moseley, in re 50 per cent. for per capita tax, etc., that this clause be adopted.

Moved in amendment by Bro. W. Norris, seconded by Bro. H. J. Wickens, that when the members from subordinate lodges are not entitled to more than 50 per cent. of per capita tax that subordinate lodge be asked to make up the difference.—Carried.

Moved by Bro. A. M. Wickens, seconded by Bro. C. Moseley, that the report as amended be adopted.—Carried.

Report No. 2, on Good of the Order.

Mr. President and Brothers,—The clause re prospectus referred back to this committee. We would recommend that the prospectus be continued without advertisements.

Signed: H. E. Terry, chairman; D. F. Campbell, secretary; H. R. Clark, J. A. Robertson, W. J. Wilkinson.

Moved by Bro. Terry, seconded by Bro. Campbell, that the report of the committee on good of the order be adopted as a whole.

Auditors' Report.

Moved by A. Kastella, seconded by Bro. W. E. Archer, that the report of the auditors be adopted.—Carried.

Moved by Bro. W. A. Archer, seconded by Bro. H. J. Wickens, that no further advertising be done until a contract is made and signed by the proper officers.—Carried.

Moved by Bro. A. M. Wickens, seconded by Bro. C. Moseley, that the suggestion of Bro. H. E. Terry, in re ritual be adopted.—Carried.

Moved by Bro. H. E. Terry, seconded by Bro. C. Peppin, that executive secretary be empowered to purchase copies of papers and send to subordinate lodges and that delegates be asked to read the same to lodges.—Carried.

Election of Officers.

Scrutineers—Bros. Bucke, C. Moseley, W. C. McGhie.

Conductors—Bros. Norris and W. Prout.

President—J. J. Heeg, Guelph, (Acclamation).

Vice-President—Bro. W. Norris, Chatham, (Acclm.).

Secretary—W. A. Crockett, Mount Hamilton, (Acclm.).

Treasurer—A. M. Wickens, Toronto, (Acclm.).

Conductor—J. A. Robertson, Stratford.

Doorkeeper—H. R. Clark, Poulette Street, Hamilton.

Moved by H. R. Clark, seconded by Bro. D. F. Campbell, that in answer to the telegram received from W. S. Dingman, mayor of Stratford, and worded as follows:

Stratford, Ont., July 28.

"Charles Kelly, president executive committee, C.A.S.E., Berlin,—On behalf of Stratford city council cordially invite you to hold next annual convention in this city, where welcome awaits you;"

That Stratford be our next place of meeting for the convention.—Carried.

Moved by Bro. W. E. Archer, seconded by Bro. W. J. Wilkinson, that hearty vote of thanks be tendered to scrutineers.—Carried.

Moved by Bro. Lamberton, seconded by Bro. J. Thompson, that warrants be issued for convention expenses.—Carried.

Moved by Bro. H. E. Terry, seconded by Bro. A. Kastella, that an order be drawn for five dollars for caretaker of Victoria Hall.—Carried.

Moved by Bro. A. M. Wickens, seconded by Bro. H. E. Terry, that votes of thanks be tendered to the following:—Mayor and council of Berlin, the Technical Press, C. A. S. E. exhibitors, Mr. Hetherington, Berlin local.—Carried.

Moved by Bro. W. E. Archer, seconded by Bro. A. Kastella, that the usual honorium be given secretary, and order given for same.—Carried.

Moved by Bro. W. E. Archer, seconded by Bro. Whyte, that our regrets be tendered to Mr. Hetherington, of Goldie & McCulloch, on account of being unable to accept his invitation.

Moved by Bro. W. J. Wilkinson, seconded by Bro. A. Kastella, that vote of thanks be tendered the examining board for information in re license law.—Carried. This was replied to by Bro. C. McGhie.

Moved by Bro. J. A. Robertson, seconded by Bro. Lamberton, that the secretary be instructed to write the president of the I. S. U., of the action taken by this association in re legislation beneficial to the profession, and asking for their co-operation.—Carried.

Moved by Bro. Bucke, seconded by Bro. Lamberton, that a resolution be drafted by the new executive and forwarded to the Legislature for its next meeting, setting forth the views and requirements of this convention relating to graded certificates and the license law. —Carried.

Moved by Bro. J. J. Heeg, seconded by Bro. W. E. Archer, that this convention pass a resolution to the Premier, asking him to consider the advisability of combining the Acts respecting the uniformity of boiler construction and the Act respecting stationary engineers.—Carried.

Moved by Bro. C. Moseley, seconded by Bro. W. E. Archer, that Bro. Kelly reply to telegram from Stratford.—Carried.

Moved by Bro. H. E. Terry, seconded by Bro. D. F. Campbell, that a vote be tendered to "Jack" Armour, of Power, for the very able manner in which he entertained us during this convention.—Carried.

Moved by Bro. A. Kastella, seconded by Bro. Lamberton, that vote of thanks be tendered to Gordon C. Keith, of The Power House, Toronto, for the many favors shown towards us.—Carried.

Replies were received from J. Armour and G. C. Keith, both of whom signified their willingness to do what they could for the advancement of the cause of the C. A. S. E.

Bro. Chas. Kelly requested Bro. H. E. Terry, past-president of this executive council, to install the new officers elected. He was assisted by Past-President Bro. E. Grandbois. Bro. H. E. Terry then took the chair and proceeded to install the officers with due ceremony.

The new officers showed their ability in a very marked manner by the magnifiecent speeches given.

After singing Auld Lang Syne and God Save the King, the convention adjourned to meet in Stratford.

The Exhibitors' Association at Berlin Convention

Their Display of Power House Equipment and Supplies Showed the Recent Development in Power Machinery, etc.---Annual Meeting of Exhibitors.

The exhibit of power house equipment was large and varied, and showed recent developments in power apparatus. The engineers showed great interest in power apparatus and many manufacturers visited Victoria Hall during the exhibit to see the many valves, packings, oiling systems, traps, blowers, safety stops, etc., displayed. There were over twenty exhibits, and these occupied nearly all the hall. The following had power equipment displays:

Goldie & McCulloch Co., Galt, represented by E. F. Hetherington and W. G. Bishop. They had catalogues of their lines of engines and boilers, these catalogues containing photographs of many of their recent installations. Each engineer was presented with a 36-inch standard steel tape.

I. E. Shantz, Berlin, represented by Milton Shantz. They had on exhibit a set of "Diamond" grate bars manufactured by them. Eighteen installations have been made in Berlin, and some of these were shown to visiting engineers. A useful souvenir in the shape of a "Diamond Grate Bar" clothes brush was presented to each visitor.

Peiler & McKenzie, Montreal and Toronto, represented by H. L. Peiler and D. Russell. Three spaces were devoted to the exhibit of power apparatus including the Berry automatic feedwater regulator, Reilly multicoil heaters, Turbo blowers, Bundy steam traps, Ashton valves, gauges, etc., Mason regulators, France packing, Mather's blow-off protectors, J. McAvity's (St. John, N.B.) gaskets, etc.

Twin City Oil Co., Berlin, represented by V. O., A. V. and L. H. Phillips. Oil pumps were shown of Manzel design. This company deals in oils and manufactures belt dressing and boiler compound.

Garlock Packing Co., Hamilton, represented by T. J. Kelleher. Samples of Tauril packing were distributed and literature on Garlock packing, Garlock pipe covering, etc. A leather pocket book was presented to each engineer.

Lunkenheimer Co., Cincinnati, represented by E. A. Wilkinson, Toronto, displayed sectional samples of a number of their steam specialties, particular attention being given to the Marvel oil pump and Renewo valve.

Dearborn Drug & Chemical Works, Chicago, represented by J. N. Gregory, Buffalo. Circulars were destributed showing the treatment of oils and feedwater. Twenty-seven chemists are employed in analyizing boiler feedwaters and oils.

Francis Duffy, Kingston, had an expansion steam trap on exhibition. This trap has been installed in many large Canadian establishments.

Strong, Carlisle & Hammond, Cleveland, represented by R. Evans. The Strong Automatic Engine Stop was on exhibition, and was in running order. Much interest was shown in the automatic stop.

Canadian Fairbanks Co., Montreal and Toronto, represented by George E. Fisher and R. L. Woodward. A very complete line of Fairbanks valves was shown, also Palmetto packing and Randall lubricator. The Fairbanks Co., presented each engineer with a folding steel rule in leather case.

Canadian Steam Boiler & Equipment Co., Toronto, represented by Z. Hemphill and J. Durst. A model Cyclone grate was shown, by which the working the grate shaking arrangement, etc., were demonstrated. The improved Economic vacuum valve was also on exhibition.

American Radiator Co., Chicago, represented by W. H. Burnett. On exhibition were the Ideal sylphon tank regulator, Ideal sylphon regitherm, reducing valve and Norwall syphon air valves. With the Norwall vacuum valve water boils at 160 degrees F. A steam testing outfit was used in demonstrating this valve.

Dart Union Co., Toronto, represented by John B. Goff and C. P. Archibald. Dart unions and couplings were shown, the smaller ones in sections. Dart unions have screw joints up to 3 inches and flange from 1 inch up. A souvenir Dart union watch fob was destributed.

Bice Regulator Co., London. A Bice regulator was set up and M. Owen demonstrated it, showing how it automatically keeps water in the boiler at constant level.

EARL F. HETHERINGTON.
Vice-President Exhibitors' Association.

Jenkins Bros., Montreal, represented by W. R. Stavert and Chas. A. Piche. Check and globe valves in all sizes, both screw and flange joints, brass and cast iron, were shown. Their souvenir was a small brass valve.

Power, New York, represented by "Jack" Armour.

Quaker City Rubber Co., Pittsburg, represented by T. A. Meyers. This company manufacturers P.P.P. (perfect piston packing), and Ebonite sheet packing. Samples were destributed to engineers, and in addition a standard steel rule in a leather case.

The Power House, Toronto, represented by H. V. Tyrrell and G. C. Keith. Identification badges were presented to engineers, exhibitors and guests by The Power House.

GEORGE E. FISHER.
Treasurer Exhibitors' Association.

Annual Meeting.

The annual meeting was held Thursday afternoon, July 28, with W. R. Stavert, president, in the chair. The secretary's report was read by John B. Goff, and adopted.

To eliminate the complications of three assessments, it was moved by E. F. Hetherington, seconded by V. O. Phillips, that $10 be charged each exhibitor for one space and $5 for each additional space, this to be the only assessment except in case of deficit; price includes membership, space and entertainment. Carried.

Moved by J. Armour, seconded by H. L. Peiler, that copies of the treasurer's report be mailed to the different firms represented. Carried.

The meeting here adjourned to the meeting of the C.A.S.E., when President W. R. Stavert was presented with a "badger" as a memento of the badger vs. dog fight.

JOHN B. GOFF, TORONTO.
President of Exhibitors' Assoc.

E. F. Hetherington was given a vote of thanks for his invitation to visit the Goldie & McCulloch plant at Preston. "Jack" Armour, of Power and G. C. Keith, of The Power Huse, were also accorded votes of thanks.

New Officers.

When the exhibitors' meeting was again called to order the following officers were elected:

President—John B. Goff, Dart Union Co., Toronto.

1st Vice-Pres.—E. F. Hetherington, Goldie & McCulloch Co., Galt.

2nd Vice-Pres.—H. L. Peiler, Peiler & McKenzie, Montreal.

Secretary—Gordon C. Keith, "The Power House," Toronto.

Asst. Secy.—D. O. McKinnon, Toronto.

H. L. PEILER, MONTREAL.
Vice-President Exhibitors' Association.

Treasurer—George E. Fisher, Canadian Fairbanks, London.

Superintendent of Exhibits—W. R. Stavert, Jenkins, Bros., London.

MOCK POLICE COURT CASE.

A practical joke in the nature of a mock Police Court trial, occupied the attention of His Worship Mayor Hahn, at Berlin, during the convention, on Thursday afternoon in the Council Chamber. About a hundred members of the C.A.S.E. and exhibitors were spectators. The plaintiff in the "trial" was W. R. Stavert, of Montreal, and the defendant, George E. Fisher, of London.

The defendant was taken into custody early in the afternoon by two policemen in plain clothes and was marched up to the lock-up, where he rested for some

GORDON C. KEITH, TORONTO.
Secretary of Exhibitors' Association.

two hours. At four o'clock he appeared before His Worship Mayor Hahn, and the charge read was that of stealing a valve the property of W. R. Stavert, Montreal. He pleaded not guilty.

"Jack" Armour appeared in behalf of the prisoner, while W. A. Crockett appeared for the plaintiff.

When Mr. Crockett appeared at the bar Mr. Armour remarked "This isn't the first bar he's ever stood before."

The testimony of the plaintiff was first submitted. Mr. Stavert stated that he had missed his valve that morning and had evidence to reveal this theory. He gave the names of Messrs. Goff, Philip, Jr., Archibald, Heeg and Fitzgerald as material witnesses.

When Mr. Philip was asked to give his evidence he stated that he knew nothing less than that he heard the valve disappeared.

Mr. Archibald said "Mr. Fisher has admitted to me that he knew of the whereabouts of the valve, and that he had some connection with its disappearance." But the solicitor for the prisoner was disinclined to believe this statement. He remarked that it was a disgrace to bring up ignominiously before the courts so upright and honest a character as the man in charge.

Mr. Goff was next called. "What do you know about this case?" asked His Worship. "I have nothing to give but circumstantial evidence," was the reply. He stated that he had seen a valve of such description in Fisher's apartments in the Walper House, room 60, the night prior to Mr. Fisher's arrest.

Mr. Armour then addressed him, "Are you a brother of the celebrated temperance orator?" The response came in the affirmative.

"Were you in room 60 at Walper House last night?" The reply came in the negative. Mr. Armour tried to make him understand that such was the evidence he had just given, but his interpretations were with seeming tears openly denied by witness.

The complainant was then asked the weight of the valve and said that it amounted to no less than 250 pounds. The prisoner was asked whether he had employed a horse and rig to cart it away and said that the valve was light weight.

Witness Fitzgerald said that he knew no more than that he assisted in removing the valve from the hall out of the way, as it appeared to be an obstacle.

Again the defendant's solicitor appealed to the presiding officer. He asked that the prisoner be discharged as there was no evidence to show that his client was guilty of so base a misdeameanor. He further stated that the complainant shoulder all costs.

The witness in further cross-examination stated that at the time of the disappearance of the valve the window was open and that probably a strong draft had carried it out. This remark was disregarded.

Armour accused the next witness of perjury and asked that the complainant be arrested.

Prosecutor Crockett then gave his view of the case. He stated that the prisoner's own admission of the knowledge of the whereabouts of the valve was alone conclusive evidence to prove him guilty of the crime for which he was arrested. He asked that immediate sentence be passed.

Then Armour got up. "I believe, after all," he remarked, "that you are a crook, a vagabond, a culprit. You look like a crook. I honestly believe you stole the valve, but," looking at the man on the Bench, "as I previously stated, the bottom of this case is knocked out, as there is no evidence to prove that he stole the valve and I ask that he be honorably discharged."

The prisoner then arose and remarked that he would take action against the plaintiff to recover $10,000.00 for defamation of his character.

Before passing the "inevitable" His Worship referred to the seriousness of the offence and then said, "I will deal leniently with you on this occasion. I will leave you off on suspended sentence and ask you to report to the authorities at London each month. Further the costs of the case will be defrayed by neither party, but I will ask the plaintiff to pay the liquidation fees." And he did too. The liquidation took place at an adjacent hotel.

CONVENTION INDICATOR CARDS.

Stratford 1911.

* * *

"Has anybody here seen Kelly," was a popular song at the convention.

* * *

Water Gauge—Two leaking rivets on the side of a boiler, one leaking steam and the other water is an "ideal" boiler water gauge. This is the latest modern (?) practice that was thought to be obsolete.

* * *

Jack Armour thinks there's something radically wrong about the Canadian customs system. He bought a box of good cigars before he left New York for $9 and had them come on by express. The charge for that was 45 cents. No kick coming, but it did make him say things when he had to dig down into his jeans for $7.80 for duty charges. Now, when in Canada, he says he will smoke Canadian cigars.

* * *

There was a real international combat in room 15 of the Walper Tuesday evening. That is the convention headquarters and sleeping place (if they ever sleep) of J. N. (Dad) Gregory, of the Dearborn Works, Chicago, and "Jack" Armour of Power. While they were thoroughly enjoying the show at the 5 cent theatre some of the Canadian Indians made an attack on their room, scalped the bed clothes off the frame and threw them into the bath tub. Then they turned the bedstead up on end, and retired to await developments. What our Yankee friends said was a shame. But that wasn't any worse than the telegram from the Two For Five Detective Agency that was sent to Mr. Armour Wednesday morning—40c collect. Stavert, of Montreal, and Fisher, of London, bought a box of bum cigars—2 for 5, and in the excitement following the bed episode Armour—who usually puffs dollar goods, really put away two of the cheap ones.

* * *

A guest at the Walper house was heard to remark: "There must have been thirteen Limburgers carved in room 16 Wednesday night."

* * *

Who's who around here anyway—ask Fitzgerald.

* * *

E. C. Fitzgerald, the Honorary President of the C.A.S.E., Exhibitors' Association, was presented with a silk umbrella.

* * *

Give the C.A.S.E. visitors a smile and be as courteous as you can when they ask questions about the town.—Daily Telegraph. They did. Some got more than one.

* * *

Those C.A.S.E. delegates believe in mixing up work and play while they are meeting in convention.—Berlin Daily. How would this mixture do for a boiler compound?

* * *

In the boxing bout between Herb Terry and Duncan Medcalf, someone remarked it was a contest between the government and the opposition. As the results show, the government was sustained.

* * *

The engineers presented the president of the Exhibitors' Association, W. R. Stavert, with a "Badger" in which was a "hot dog," as a memento of the dog vs. badger fight. By the way did you see the fight?

Milton Shantz, of the Diamond Grate Bar Co., Berlin, leaves about August 1 for a trip through the western provinces in the interests of his company.

W. R. STAVERT, MONTREAL.
Chairman Exhibit Committee.

STEAM AS A MOTIVE POWER.

By A. M. Wickens.*

The stationary engineer of these times and more especially those operating in localities in the vicinity of our large water powers are to-day wondering what is to be the outcome of all this agitation about electric power. That long distance transmission has made it possible to apply electric energy to drive many of our manufacturing establishments we must fully realize, also that the cheapest and most reliable power is the every day demand of the factory owners. We must also recognize that producer gas and gas engines are a factor to be considered in the settlement of what power this or that manufacturing concern is to use in the future, consequently we should take some pains to get sure information as to the cost of operation by any of these several methods of driving our factories. We should carefully consider each of these several plans for power before deciding which is best to adopt for each particular case. It is only by fully and carefully studying the total requirements that we can arrive at a just decision. The electrical companies are fully aware of this and will have their representatives visit steam plants for the purpose of first finding out the actual power used by the various machines, also the total power used including all costs, such as fuel, water, oil, wages and in fact anything about the plant that can be used in computing the actual cost of power. When this data has all been collected and tabulated it is turned over to their expert whose duty it is to make a statement showing that electric current at the price quoted is cheaper than the operation of the existing steam plant. In many cases the steam plant may be running very badly, engine valves poorly set, boiler badly set and poorly fired with a result that the steam was costing perhaps double the amount per h. p. that it should. In a case of that kind our electrical friends win out easily. When they meet a case where a well designed and carefully managed steam plant is in operation their task is rather more difficult. In fact there are many cases where the steam plant proves to be the best means to use for power. A paper recently read at The Canadian Electrical Association meeting, entitled "The Commercial Agent and the Community" in part says:

> "Essentially this is the day of specialties, and what is needed is the man who can present the different uses of our services in detail, commanding attention because of his minute familiarity with the subjects discussed."

Also that:

> "It is the duty of the New Building Bureau to prevent, if possible, the installation of a private plant, but, unfortunately, we are not always successful in this noble endeavor and plants do go in, in spite of our hard work. When a plant has been installed it becomes the function of this bureau to prevent its operation or after operation, to secure its abandonment. This bureau has a complete record of all plants in the city, but a general canvass of this is impossible, each case having to be studied carefully, the items of cost determined, and the results compared with the operation from central station service. But only when we can persuade an owner that our estimates are to his advantage are we able to secure the business. During 1909 this bureau succeeded in closing down 40 plants."

This company maintains an engineering bureau. The members do no canvassing but work with any of the other bureaus. For instance, a large office building is to be erected and the owner is in a quandary whether to instal a plant or use our service. This bureau immediately begins a detailed study of the lighting, heating, power and other problems that are involved, reporting the details to the New Building Bureau in such shape that the matter can be convincingly presented to the owners. We have found this bureau of inestimable value in the canvass of many of our large building propositions and by the study thus made have been able to controvert the biased reports to the owners or engineers favorable to a private plant, and have thereby secured the business.

Here let me remark that it seems strange that the writer of that paper claims that engineering advice from steam or mechanical engineers should be biased, while the advice of electrical engineers would not be so, especially as they are paid for their ability to close down steam plants.

It is now time the builders of engines and boilers realized that many of their sales methods should be changed and that each sale be studied out so as to give the customer the most reliable and cheapest power possible under the circumstances they are to be operated under. Our engine and boiler makers too often think they are not interested in the machinery after it leaves their possession and in a measure they are not, but the result is that very often the buyer has not purchased either engine or boiler that is suited to his requirements and consequently the cost of operation is largely increased and the plant is an easy mark for the electric companies or the gas producer salesman. When our engine builders apply some of the above methods in selling and when our buyers will consult disinterested and practical engineers results would be such that electrical companies would have to cut prices and even then have trouble to shut down steam plants.

Steam Economy.

This applies more particularly when the exhaust steam from the engine is used for heating buildings. For dry kilns or for manufacturing purposes where steam of a low pressure will do the work. A well designed boiler carefully set and having ample draft will evaporate about 9 lbs. of water per pound of coal burned and the efficiency would be from 65 to 70 per cent. An engine well designed and of proper size for the work it is intended to do will give a h. p. for about 26 lbs. water per h. p. per hour. This means 3 lbs. coal per h. p. per hour and at $3.00 per short ton .5 of a cent per h. p. per hour. This for one year's run would cost approximately $1,350. If the exhaust steam is used for heating the buildings for seven months in the year, it would save the cost of coal used for that purpose which should save at least 100 tons coal or $300. We still have steam left to use in dry kilns and for other purposes so we may say that we can utilize for all purpose a large per cent. of the heat units in the coal. Say the boilers have an efficiency of 70 per cent. and that the engine efficiency is 10 per cent., we still have 60 per cent. of the original heat units to use for heating and manufacturing purposes. So if we utilize the whole of them we should reduce operating cost of the factory to nearly one-half of the cost of the coal for the boiler and engine. If we do not use up all the exhaust steam for every purpose possible we throw away ninety per cent. of the heat units supplied to the engine. In cases where electric or producer gas is the power used the cost of heating the buildings and also any steam used for manufacturing purposes should be added to the cost of the electric current or coal for gas producers. Many factories increase rapidly and soon want greater power than was at first installed and it is some times a problem as to how to get the extra power either on account of space or perhaps intial cost.

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* Chief Engineer, Canadian Casualty and Boiler Insurance Co.

The development of the low pressure turbine has proved to be a useful factor for cases of this kind. It has been found that by the addition of a low pressure turbine set to take the exhaust steam from a reciprocating engine the capacity of the plant was practically doubled and this without any increase in boilers or any increase in labor. It is found that nearly as many heat units can be converted into mechanical work by these turbines taking steam at 2 lbs. above atmospheric pressure and carrying a 27-in. of 28-in. vacuum as the reciprocating engines had converted into work while expanding the steam from 100 lbs. initial pressure down to a release pressure of 2 lbs. above atmospheric. There have been several notable instances of this means of increasing the power of existing plants demonstrated during the last few years. The Philadelphia Rapid Transit Co., The Scranton Street Railway and a large plant in East St. Louis are striking examples of what can be done along these lines. A 1,000 h. p. engine was running non-condensing, using 2.5 lbs. of coal per h. p. per hour. The addition of the low pressure turbine doubled the capacity of the engine and reduced the water consumption down to 1.25 lbs. coal. In a case where the steam plant was of the highest order running cross compound engines using superheated steam and a high class plant in every particular, using 25 lbs. water per h.p. per hour, it was reduced to 15 lbs. per h. p. per hour by the addition of the turbine. If a full knowledge of what can be accomplished by the use of steam is followed by our engineers and engine builders, the number of steam engines discarded for other drives will be very small. I may also say that a good steam plant under a first class engineer will run with fewer losses from shut downs than any other means now known.

Some Considerations Affecting the Choice of an Engine

First Cost, Reliability, Steam Consumption, Availability of Condensing Water—Use of Exhaust Steam for Heating Purposes, and Total Operating Cost.

By Arthur K. Spotton *

When it has been decided by any one that he must purchase a power plant, there are always certain considerations which will affect his choice of machinery, and it is the intention in the limited time at our disposal to touch on some of these considerations, which are most commonly met with by members of this association.

The chief points to be studied in determining the type of engine best suited to the requirements and conditions are:

1. First cost.
2. Reliability, attendance and workmanship.
3. Steam consumption and steam pressure available
4. Availability of condensing water.
5. Use of exhaust steam for heating purposes.
6. Total operating cost per year.

In enumerating the above items it has been presupposed that the location of the plant is such that any type decided on can be placed in the power house and properly installed and that the purchaser is possed of sufficient funds to finance the proposition—for should the room be too small or the power house not provided with the proper handling facilities or the purchaser be cramped for money, there are introduced factors which prevent the installation of a plant which will give the best economic results. Here would be a good place to enter a protest against the too common feature of a large buildings in which the engine room is placed in any corner that cannot be used for anything else. The possession of a clean, well lighted and ventilated engine room is an absolute necessity for the best economy and the effect of such an engine room is easily seen, and where a dirty, unkept engine room is found it is pretty certain that the engineer has no clear conception of what his engine is supposed to do or how to improve the economy of his plant.

About the first thing that comes up for consideration in the purchase of an engine is the initial cost and to a customer unacquainted with the details of engine construction and economy, this is usually a big item. To determine whether a certain amount of outlay is to pay, the advice of his engineer is imperative. The usual method of procedure is to call for tenders on an engine of a certain horse power, and to avoid unnecessary work and worry, only those manufacturers who are known to be reliable, and whose product is first-class, and who make a specialty of this particular class of goods should be asked for prices. This usually brings the number of tenders down to four or five. Before proceeding further the intending purchaser should make out a form sheet for tabulating his results such as is shown in Fig. 1. The prices should then be tabulated, and the cost of their respective foundations added. From this can then be calculated the overhead charges, which include interest on investment, insurance and depreciation. This latter item is more or less a definite percentage of first cost, which is the same for all first-class engines of any particular kind, but it is advisable for the engineer to visit several plants where the various makes of engines are running, and by inquiry obtain such information as will lead him to determine

NAME OF TENDERER	TYPE OF ENGINE	COST F.O.B. CARS	FREIGHT	COST OF INSTALLING	COST OF FOUNDATION	TOTAL COST	INTEREST	INSURANCE	DEPRECIATION	WORKMANSHIP AND RELIABILITY	ATTENDANCE	STEAM CONSUMPTION PER B.H.P.	STEAM FOR AUXILIARIES	COST OF FUEL FOR RATED LOAD	% OF STEAM AVAILABLE FOR HEATING	COST OF FUEL FOR POWER ONLY	TOTAL ENGINE COST PER AVERAGE H.P. PER YEAR

Fig. 1.—Sheet for Tabulating Results.

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* Chief Designing Engineer, Goldie & McCulloch Co., Galt, Ont.

his yearly item of depreciation. When all this has been settled and his totals compared, the engineer should lay aside his figures and proceed with the next consideration.

Reliability and Attendance.

The question of reliability can only be settled by an examination of a number of plants in which engines are running of the particular make under consideration, and the great value of knowledge gained by personal observation cannot be too strongly emphasized. This information should be gathered by the engineer, and a visit to the shops where the engines are built is the only way to settle the question of workmanship. What the specification says in this regard should not satisfy the engineer as the various points of manufacture which effect the general reliability of the machine cannot be gone into in a general specification. Any manufacturer who claims to turn out a first-class article, and has any basis for such a claim is only too anxious that a thorough examination be made of the details of construction by an intending purchaser. On the preceding chart will be found another column for design and workmanship, and also a column for repairs. The first of these columns could be filled in with words: "Good," "Very good" or "Best." Any engine which cannot be designated at least "Good" should not be considered at all, as a poorly constructed machine is the worst kind of an investment. From an examination of the design, workmanship and running of each engine, enough information can be obtained to determine approximately the annual repair and supply bill, and the amounts fileld in in the proper column.

There should then be added to the chart the figures belonging to the column for the cost of attendance—This includes the wages of the engineer. This item is practically the same for all classes of steam engines of the same capacity as it requires at least one man for even the smallest unit, and for larger units the number of men will depend considerably on whether two shifts or one are necessary. There are installed many steam plants of 1,000 horse power maximum capacity with their attendant electrical apparatus in which the engine room is easily taken care of by one man per shift.

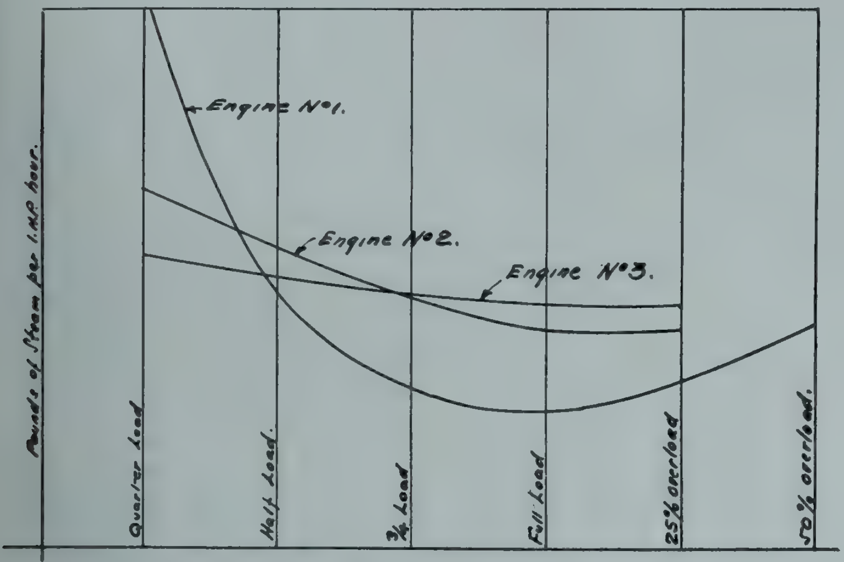

Fig. 2.—Curves of Three Engines.

Steam Consumption and Steam Pressure Available.

This item of steam pressure is one that is determined by the boiler installation and should be stated in the inquiry for tenders. It is usually given in pounds per square inch at the boilers and the engine builder has the right to expect that the piping will be installed in such a manner that the pressure at the throttle will not be any less than ten pounds below the boiler pressure. The builder should, if possible, also be furnished with full information as regards the various loads, which the engine will carry, with the length of time such loads are on the engine, to enable him to figure the engine which will give the best average results.

All good engine builders are prepared to give close guarantees as to the amount of steam per horse power which the engine will take at various loads, and the specification should be accompanied by a curve showing this steam consumption. This curve will show much more clearly than mere figures the rates of consumtion at various loads. When all the tenders are in the engineer should then transpose these curves to one chart so that the guaranteed steam consumption of the different engines can be more easily compared, and a vertical line drawn through the chart at the point of average load.

It is commonly supposed that a flat economy curve is desirable in an engine. This is true, if the whole curve is low down on the chart, but it is not right to assume any special virtues for the engine because of this flat curve. Fig. 2 shows three such curves laid out. These curves are plotted from the guarantees of the various makers. This shows that for all loads from about one half the rated load to full overload, engine No. 1 is the more economical. For lighter loads than one half both No. 2 and No. 3 are more economical than No. 1. In some rare instances where the average load is very light, compared to the rated load, and where the engine has been intentionally made large to carry an enormous overload, such engines as No. 2 and No. 3 would be the best propositions. But where the average load cannot be determined with any degree of certainty, it is best to be guided by the steam consumption at rated load. It is, however, adviseable that the engineer before decid-

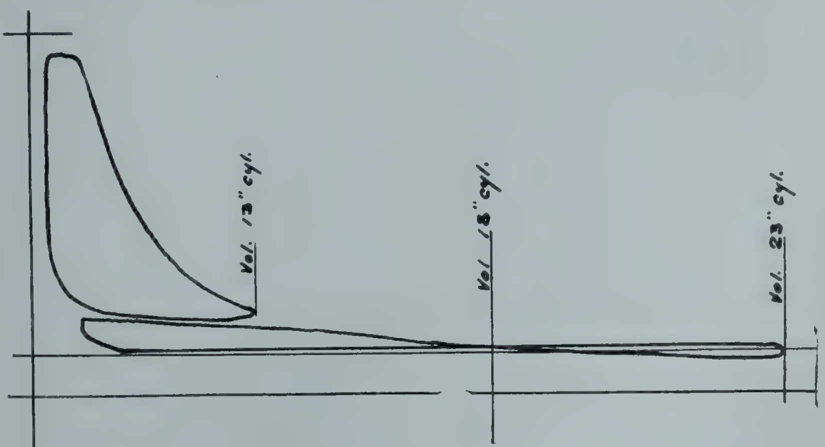

Fig. 3.—Card From Engine 13 and 23 x 30.

ing this point to insist that the engine builder furnish data of some actual test made on one of his engines—made by an independent engineer—which will show that his guarantees are based on actual experience. When this is done the next item on the general chart, that of "Fuel Cost," can be calculated from the steam consumption of the engine added to the steam taken by auxuliaries, and the evaporative efficiency of the boilers.

Availability of Condensing Water.

The fact of water being available or not for condensing purposes will determine in a large measure the type of engine most suited to the requirements, and has a particular bearing on whether the engine shall be a single cylinder or a compound. There is an erroneous belief current among engine users that the compound engine is under all circumstances a more economical engine than a single cylinder engine. This is not true. A compound engine is the more economical only when the load and conditions are suitable for economy, and this is especially so when the engine is noncondensing. The number of plants is very great where a noncondensing compound engine is installed under the false impression that greater economy would result than with a single cylinder engine. In explanation of this let us take the combined indicator card from a noncondensing compound engine, Fig. 4. For any given rated load it is abvious that to get good results the terminal pressure must be above atmosphere, and a terminal drop of at least two pounds should be figured on and to get a sufficient overload capacity the cut-off in the horse power cylinder at rated load should be about 1-3. Thus suppose that we have an initial pressure of 120 gauge or 135 absolute and suppose No. 3 back pressure is required for heating, and we allow No. 2 terminal drop, this would make our absolute terminal pressure 15+3+2=20, giving us (if we neglect clearances) $\frac{13.5}{20}=6.75$ total expansions, and with 3 expansions in the horse power cylinder a cylinder ratio of $\frac{6.75}{3}=2.28$. Now if for any reason the cylinder ratio has been made greater than this, or the cut-off in the horse power cylinder is lessened to accord with a load lighter than rated capacity the result be a terminal loop in the L.P. card.

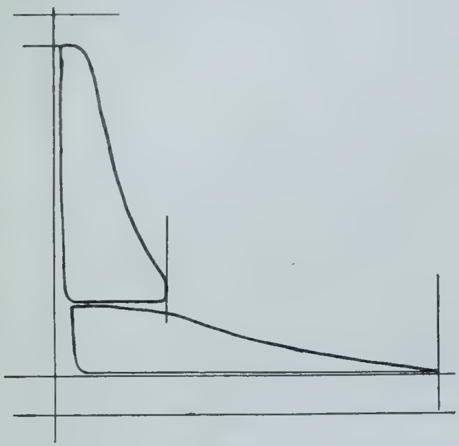

Fig. 4.—Combined Card.

Fig. 3 shows cards actually taken from an engine with cylinders 13 and 23 x 30. This card shows that this engine, if it had been provided with a smaller L.P. cylinder, about 18 inches in diameter, would have given more horse power for the same amount of steam admitted to the horse power cylinder. As a mater of fact, for this particular load it would have been better to have had a smaller single cylinder engine.

Fig. 4 shows a set of cards taken from a non-condensing compound engine working at about its most economical load. It is obvious, however, that if the load is lessened the result will be a loop in the L.P. card. This loop is an inherent feature of a noncondensing compound of the automatic cut off type, and is bound to occur at loads below a certain amount with a resultant loss in economy. It is therefore necessary when figuring on a non-condensing compound engine, to have very accurate data regarding the loads and steam pressure to be carried.

Exhaust Steam for Heating.

In a climate such as ours, and where the majority of the steam plants are in connection with some sort of factory—the problem of heating the buildings is naturally one of importance, and where such a heating proposition has to be taken care of, this question will have a great influence on the choice of an engine. The average length of time during which such heating has to be done is from six to seven months or approximately 50 per cent. of the running time of the plant. The first thing to decide is the probable amount of steam that is necessary for such a purpose, and should be tabulated on the chart as a percentage of the total amount of steam used by the engine. When this is determined the amount of coal necessary to produce this steam can be calculated, and the engine credited with it. That is, to find the cost of power only, the amount of fuel necessary to heat the buildings should be deducted from the total amount. This is not strictly true, but is very close for an approximate. The reason of this is that the heat available for heating purposes in a pound of steam, at two or three pounds pressure, is nearly as much as at high pressure. The reason for this is what is known as the latent heat of steam. This latent heat is the heat that is required to turn water into steam, thus, if we take water which has been raised to 212 degrees F. and apply still more heat to the water the water will commence to evaporate into steam, but the temperature will not rise above 212 degrees, providing the water or steam is not confined in any closed vessel. For every pound of water which is converted into steam, there is absorbed by the water 966 B.t.u., without in any way raising the temperature or pressure of the steam. If this steam is confined in a closed vessel, such as a boiler, the pressure and temperature will naturally rise with the continued application of heat. After the water has been converted into steam, and we desire to raise the pressure of the steam above atmospheric pressure, say to 100 pounds gauge pressure, it will require a further application of 120 B.t.u. per pound of steam to raise it to this pressure. If this steam is now admitted to the cylinder of a steam engine, and there allowed to expand thereby doing usual work, and the pressure again reduced to that of the atmosphere, we still have in the steam the 966 B.t.u., which it had absorbed by being converted into steam. If this steam is now taken and put in heating coils in the building, and allowed to condense into water again, it will give up to the surrounding coils, and the atmosphere the 966 B.t.u. It will thus be seen that the exhaust steam contains for heating purposes nearly the whole of the heat given up to it by the coal and that a heating system using the exhaust from a steam engine will use very little more coal that a low pressure boiler alone without the engine, and that in a factory where the whole of the exhaust steam can be used for heating purposes the fuel cost of power obtained from the engine is almost nothing during the period in which this exhaust steam can be so used. If the whole of the exhaust steam cannot be used for heating purposes, that portion not used, is in the case of non-condensing engine, discharged to the atmosphere, but where a compound condensing outfit is installed it is a simple and economical arrangement to take the steam for heating from the receiver between the high and low pressure cylinders. The pressure usually carried in the receiver of a condensing compound engine, is from five to ten pounds gauge, and is therefore admirably suited for this purpose. The only effect of taking this steam from the receiver is to reduce the area of the low pressure card, but it possesses the great advantage of providing the heating system with just the amount of steam required without robbing the engine of the economical advantages of running condensing.

In considering the amount of steam required for heating purposes, the same consideration should be given to such steam as is required in the various processes of manufacture in the plant, such as occur in knitting mills, tanneries, packing houses, etc., where a large amount of hot water is required, and where the exhaust steam can be used to heat this water.

These are some of the considerations which affect the choice of an engine for any particular proposition, and it is urged that when a selection has to be made the whole problem should be gone over carefully rather than that some type be selected on account of one particular virtue. This applies not only to steam engines, but other sources of power as well, and the attractive statements of low cost of power per horse power hour are often misleading, as a tabulated statement taking into consideration all the items in connection with the cost will frequently disclose an entirely different state of affairs, and the only safe way to estimate cost of power is to figure the total yearly expenditure and not the cost per hour under some particular set of circumstances.

If the total yearly cost of power for any particular plant is required the cost of boiler installation and operation will, of course, have to be considered in the same way as the engine, and this item added to engine cost. In presenting this paper, however, the object has been to draw attention to some considerations in respect to the engine only.

The subject is such a broad one that it is not possible in a short time to completely cover the ground, but it is hoped that the suggestions contained in this paper may lead to a careful consideration of power house problems, and a judicious selection of motive power.

"The Saving of Heat Units" is a Clue to Larger Profits

How a Leak of $2,600 was Turned into a Profit—How Manufacturers and their Engineers Can Turn Waste into Profits by Taking Care of Condensation.

By H. L. Pelier *

Modern engineering presents to its students many fascinating features.

Civil engineering has achieved many trimphs of construction, and in its discoveries of the practical application of theory to the utilization of the special qualities of steel and concrete, has overcome so many difficulties, has raised so many and such various monuments to its own skill, that the average man is lost in admiration while contemplating the results.

Electrical engineering, while relatively an infant branch, has made such rapid and brilliant strides that we already regard as ordinary commonplaces achievements that less than one generation ago aroused the wonder of the world. It is really difficult to realize how very youthful are such every-day utilities as the incandescent lamp and the telephone. Long distance transmission of currents of relatively high potentials only dates from yesterday.

In mechanical engineering, while progress has been steady, it has not been so rapid, and the advances have come in short rushes with a rest between. In recent years, we have progressed from the single cylinder engine to the compound, from the low-pressure slow-speed engine to the high-piston speed, long-stroke and quick revolution engine necessitating high pressures. Then comes the development of the turbine principle and as a crown to all of these, the successful application of the superheating of the steam. Keeping up with the development of the engine, the steam-generating plant has also progressed, and boilers with their accessories from grates, mechanical stokers, automatic feed-control and other fuel-saving attachments, make the modern boiler-room a very different proposition from that of even fifteen years ago. In another direction, we have the internal combustion engine in its various forms and many other devices for cheapening the cost of power-production and simplifying the complex problems that confront the present day manufacturer when he is contemplating his costs.

In view of all these bright and outstanding achievements in the mechanical world, it seems as if it might be a very difficult task that I have undertaken when I presume to address you on such a commonplace topic as that which has been chosen for me.

I am in the position of the gleaner of the scriptures. Before me have gone the reapers and the binders, they occupy the whole skyline because their work is more prominent. But in their haste to show large and brilliant results, they have neglected the apparently small waste that lies scattered here and there in the furrows, so small perhaps that it has to be searched for, and yet, in the aggregate, so large that its accumulation hour after hour, day after day, and month after month, presents at the end of a whole year a sum total that is surprising.

Waste of Hot Water.

On going over a certain plant with the owner, I asked him where a particular return line led that originated in a dry-room. He replied that it emptied into the drain. I asked how much water he was losing, and he stated that it could not be much and that the water was cheap. However, I managed to arouse his curiosity sufficiently to have the pipe uncovered and the water measured. To his surprise he found that a 50 gallon barrel was filled every 40 minutes and that the temperature of the water near the outlet of this large drier and while still under pressure, was 306 F. His engineer calculated for him the approximate cost, in tons of coal, of heating nearly 250,000 gallons of water from 50 F. to 300 F., and this manufacturer came to the conclusion that he was not sufficiently wealthy to continue that system, when at relatively low cost, the same water could be returned to the boilers direct and without loss of heat-units. This plant had almost every practical device for making steam cheaply. High-class boilers, modern engines, approved equipment everywhere, including ball-bearing shafting and everything to reduce friction loss to a minimum, and yet this was only one of a series of "leaks" that were discovered during a careful investigation, and eventually he found that leaks, which cost him $1,800 to stop, had for years previously been trickling $2,600 annually into the drains. Everybody possible had apparently been done to make the whole plant modern and up-to-date, which is equivalent to saying "economical to operate," but the men in charge had neglected to "look into the furrows." This is only one of a series of similar incidents which I can recall in my own experience.

I am a hunter of leaks, and this saving of the heat-units in the water of

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* Of Peiler & MacKenzie, Montreal.

condensation, while being on a superficial view only a very minor matter, is one of those smaller details of the engineering field that seems to be fated to be left to some hanger-on of the profession like myself, and it keeps me very busy gleaning what I find in the furrows. If I were permitted an attempt at a joke, even on such an apparently mirthless topic as condensation, I could say that it keeps me constantly "in hot water."

Present Day Conditions.

For purpose of comparison, it is necessary for me to state briefly the conditions that are most frequently met with in steam-using plants in this country. They are of course quite familiar to all engineers. The steam is trapped at the point of discharge at the apparatus in which it is used. The water is then usually run by gravity to some low point, gathered in an open heater, vented receiver or hot well, and after the make-up-water has been added, the boiler is fed from this central reservoir. Where the steam is used under very low pressure (0—5 lbs.) and where exhaust steam from the engines is mixed with this low-pressure live steam, the temperature of this water of condensation upon reaching the receiver is frequently under the boiling point and the addition of the cold make-up water further reduces it to a point where it can readily be handled by a good hot-water pump. Under these conditions, it is not uneconomical to handle the returns in this manner. But here I would like to point out that in drawing hot water from an open heater or receiver, and passing it through a pump, the tempersture is still further reduced, and many engineers who have thermometers on the heater or receiver, overlook the important fact that in most cases they lose from 8 to 12 degrees between the heater and the point where the feed-water enters the boilers, and that this means a direct loss of from 2-3 to over 1 p.c. of the total fuel consumption.

However, there are very few plants that answer to this description. In nearly every industrial process in which steam is used for heating, drying or boiling, it is more economical to use higher pressure in order to obtain the greater rapidity of result from the higher temperature. Even in paper mills and the finishing departments of textile mills it is usual to find pressures of from 5 to 10 lbs. used for drying. In laundries, in breweries, in confectionery boiling, in wool and cotton drying and many other lines of work, 60, 80 and even 100 lbs. pressure are usually employed, and in all these cases the pump and receiver method is wasteful. It must be remembered that in a dry-room, for instance, on which 80 lbs. pressure is carried, the water of condensation as it leaves the outlet, and while still under pressure, has almost the same temperature as the steam from which it originates, that is to say about 320 degrees F. When this water reaches atmospheric pressure, it at once cools by expansion to the boiling point, and throws off 108 degrees of its temperature, and a considerable portion of its own bulk in the form of expansion vapor, all of which is a dead loss. It is manifest to the most inexperienced new hand, that if this water can be carried back direct to the boilers without being allowed to expand, there will be an absolute saving of the amount of coal necessary to re-heat this water by the 108 degrees that it has lost. When one recalls the fact that steam or hot water under even 5 lbs. pressure has a temperature 16 degrees, at 10 lbs. 28 degrees, at 30 lbs. 62 degrees and at 60 lbs. 95 degress above boiling point at atmospheric pressure, and that between 10 and 12 degrees increase in the temperature of the feed-water means a theoretical saving of 1 p.c. in the fuel account, it follows as a natural consequence that it is wrong in theory as well as in practice to cool off water and then spend good money in replacing a loss of heat that can readily be retained and used over again.

Stormont Mill Installation.

If the water can be returned into the boilers above the evaporation point, at atmospheric pressure, the gain is very much larger in proportion than if the boiler-feed is below the boiling point. The reason for this is that the working capacity of the boiler has been changed, and has been brought to a state where the boiler is more efficient in heat-units. This difference of efficiency must be also credited to this method of feeding, and the change will naturally show greater total results, than if the saving has been computed from changes due to the difference in the temperature of the feed-water alone. I give one interesting case out of a number I have met in my own experience. In the Stormont mill of the Canadian Colored Cotton Mills Co., at Cornwall, Ont., when the average temperature of the boiler-feed was 165 deg., five 80 h.p. boilers were used to do the drying and dyeing. Under the re-arrangement now in force, about 80 per cent. of the feed-water goes back direct to the boilers through return traps at 280 degrees, the make-up water at 140 degrees making the average temperature of the boiler-feed 252 deg. F. This shows a gain of 87 degrees with a theoretical saving of about 8 to 9 p.c. in fuel. In reality, two of the boilers have been shut down, the other three are more efficiently operated, and the actual saving in fuel is over 30 p.c. allowing for the fact that a portion of the dyeing plant has been removed to another mill. This was originally a receiver and pump lay-out with the make-up water running into the receiver-tank to cool the returns, and nothing was done by me, except to handle the returns independently from the make-up. The cost of making the change actually pays for itself in this plant every six months.

In many sections of Canada, and particularly throughout Central and Western Ontario, another consideration is that of the quality of the feed-water. Every engineer realizes the value of using the condensation over again, and how much it improves his general conditions to minimize the amount of fresh water that is fed into the boilers, and most of which in many places has to be paid for. And yet, for some unknown reason, I find many plants where the engineer appears to have failed to convince his owners. Only last week I was in a factory in Western Ontario, where the feed-water is so bad that the 2-inch feed pipes to the boilers are practically choked up completely every four weeks by the heavy deposit of solids from the water. In this same plant, the exhaust from two engines and four pumps is utilized for heating water for manufacturing purposes, but every drop of this valuable condensation is allowed to run into the sewers. Enough distilled water is wasted to feed one 125 h.p. boiler practically continuously.

If it were a matter of enormous expense or engineering difficulty to save and use this water, one could understand the objection. But it is such a simple problem, and as this water is always at or near the boiling point, the saving in fuel would also pay for the cost in a reasonable time. All that is necessary is an oil-separation system, and a trap or pump that will lift this water back to the feed system.

While the attention of power users in Ontario and elsewhere at the present time is being largely attracted to electricity, this also opens up an equally large field for the steam-trap, especially the return trap. While we have our good Canadian climate to contend with, and while we need heat for boiling, drying and other purposes, so long will we require steam. Where steam is used for heating only, the return trap will operate efficiently with a much lower boiler-pressure than is required to work a pump. However, it is entirely automatic and its simplicity, lowness of operating and up-keep cost, and other advantages, make the return steam-trap in every way more desirable than a pump for boiler-feed purposes.

Where the lift from the lowest point of drainage to the top of the boiler is low (say, 6 to 8 feet), a boiler-pressure of 6 to 10 lbs. is ample.

A very little experience will show that results will be obtained much lower in cost than by any other system of heating. There is no loss of heat-units between the point of drainage and the boiler. This is the important factor of saving.

Another equally important matter, and in fact one that in some cases is more important, is that of the proper trapping ot steam-using machinery of every description. It is a point that has been very much neglected by the engineering profession. The steam-trap in general has been condemned by many engineers and is a cause of dissatisfaction in many factories and plants. An examination of the conditions will often show the reason. The chief reason, in my experience, is that steam-traps are seldom purchased intelligently. This may appear to be a strong statement to make, but it is an absolutely true stricture, and one which I am able to substantiate.

Causes of Trouble.

The first great cause for this, is that extremely few engineers take the trouble to find out what the actual quantity is in pounds or gallons of water that is condensed in any given process or machine. The ratio of water condensed from steam varies enormously according to the service performed by that steam. It is ordinarily calculated that one square foot of radiation used for heating an ordinary building will condense .625 of a pound of water per hour, when the building has been heated to 68 degrees F. But this will vary according to the construction of the building, the amount of glass surface and the humidity of the air as well as its changes in a given time due to wind. Condensation in a dry-room will vary according to the moisture of the goods being dried. A mangle in a laundry will condense more steam or less, accordingly as the quantity of the goods passing over it in a given time is greater or smaller. Indirect coils where air is forced over the pipes, will show enormous differences when the air is drawn from out-of-doors and when the air is re-circulated within the building. A vacuum pan will condense steam much more rapidly than a pan in which the same liquid is boiled at atmospheric pressure. Every process shows different results, and a proper test of the quantities almost invariably shows that the ordinary methods of guess-work run from 25 p.c. to 50 p.c. too low. It is quite usual to find a steam-trap with an interior valve-opening of ½-inch, and actually able to discharge about 10 lbs. of water per minute with 5 lbs. pressure, placed where it has to take care of double that quantity of water, a thing that it is not possible to do. The trap floods, it refuses to do work that is against all natural laws, and in consequence the trap is blamed, and not the man who attempted to force it to do impossibilities. A certain amount of blame also attaches to the engineer, because the chances are that he probably did not by actual personal investigation, find out for himself the size of the opening through which the water jhad to pass. On the other hand, a certain amount of blame attaches to the makers of these traps, who fail to inform the engineering public of this most important detail in trap construction.

Ordinary so-called catalogue ratings are useless. They are usually based upon a fixed pressure of, say 50 pounds, and their drainage capacity in feet of one-inch pipe, is misleading. No allowance is made for varying conditions, and a trap that will handle a given quantity of water at 50 lbs. will do nothing like that amount at 5 or 10 lbs. pressure.

Every engineer knows that in order to obtain from steam the heat-units which he wishes to utilize, he must first condense that steam. Engineers know that in order to obtain the best results, the apparatus must be drained quickly, and most engineers know that condensation does not usually leave the apparatus in a steady stream, but that the water nearly always comes in gulps and sudden gushes. It is this maximum condition that must be taken care of by the trap, and the most economical and useful trap is that which is a little larger than the actual average condition calls for.

With steam traps, as with every other kind of machinery, it is mistaken economy in every way to buy too small sized units. The over-loaded boiler and the over-loaded engine are expected to give poor results in the long run, and yet I think I am not in the least guilty of exaggeration when I make the statement that fully 60 p.c. of all the steam-traps in use in this country are overloaded and expected to do work of which they are not capable. This means another direct loss in the efficiency of the apparatus being drained, and in many cases reduces the output as much as one-half.

I wish to emphasize this important feature, and it covers the two great points to be aimed at in the economical handling of condensation, namely, that, first, all steam-using machinery should be amply and quickly drained, and secondly, the water of condensation kept under pressure and returned direct to the boilers without loss of its heat-units.

Trap System.

The method of doing this is simple. A proper system of proper traps will do the work automatically. The upkeep expense is practically none, and depreciation allowance less than that of any other part of an ordinary power-plant. Return lines should be covered to retain the heat in the water ; this is a practice which I always suggest and which the results justify.

It is usual in most steam-using plants to cover the supply pipe and leave the return pipes uncovered. You will tell me that the reason for covering the supply lines is to prevent excessive condensation in the line through radiation of heat through the pipe. My argument goes farther. Prevent that same radiation loss in the return. It represents just as much cool on the return side as in the supply side. If you can handle your water into your boilers under pressure as hot as you get it, why allow any unnecessary loss at either end ? Pipe-covering only represents a small first cost ; loss of heat by radiation represents a perpetual expense in coal.

By a proper trap I mean one of ample discharge capacity, and not a trap of the kind that requires a cooling of the water to open its valve, such as the usual expansion type. Remember that your object is to utilize as fully as possible every heat-unit contained in the water as it leaves the place of condensation. The rest is merely an application of ordinary common sense and reasoning power. Get your condensation back above the boiling point at atmospheric pressure, and you are making money.

It is difficult to imagine what argument any owner or engineer can set up against the proofs of economy that can be submitted in favor of this method, and yet I find that many owners and engineers of plants where the old methods exist have the greatest prejudice against venturing on a change that is such a simple and reasonable one. I have made these changes in a great number of industrial establishments, and in every case the owners have expressed their regret that the change had not been made sooner.

One question has been frequently put to me, and that is : "If this thing is so simple and if the saving is so large, why has it not long ago become the general practice ?" "Why is it not the rule rather than the exception ?" My answer to this is that this is a young country, and that technical education was until recently almost an unknown quantity. Our conditions in the early days were peculiar. We had an apparently unlimited amount of fuel at our doors, and we were a wood-burning nation, even our railways burning the wood that was piled up everywhere, a refuse from the clearing of the land. Then we began to manufacture, and every aim was directed at increase of output. Go to many of our largest manufacturing establishments to-day, especially those that have grown with the country during the past thirty or forty years, and I can instance numbers where the original plant can be traced, now a small corner of a large factory. Around it have grown the subsequent additions and extensions, a new building here, another there, not built and located according to one preconceived plan, but simply thrown on anywhere where room or convenience dictated, to meet the temporary exigencies of our growing time. "Output" has been the moving factor.

In the meantime, cheap fuel has gone and coal must be bought. Competition has arisen in nearly every line that compels closer margin of profit. Every effort is made to procure the latest types of machinery, the most modern processes, more skilled labor. But it has only recently come to the point that every other means for cheap production having been exhausted, the manufacturer is forced to turn his attention to other methods of increasing his ever smaller margin of profit.

There is no other line left open. Wages must remain at their present high level, owing to other economic conditions. Other charges are fixed by persons whom the manufacturer cannot control, raw materials are bought in the open market where his competitors have an equal chance, and his finished goods have prices fixed largely against his will by outside competition. The days of monopoly are gone almost without exception, and therefore he must look to decreased running costs. The United States Steel Corporation are to-day the largest buyers in the world of labor and fuel-saving devices. Only thus can they hope to increase the narrow margin between profit and loss.

This stage has only recently been reached in Canada, and it is now being forced upon the attention of all mechanical engineers.

In the eastern United States the principles which I am laying down in this paper, have been longer recognized, and I am not preaching the gospel of experiment. The methods which I am endeavoring to spread, are the result of twenty years continuous effort along these lines by engineers of experience, and to-day we can handle the most varied conditions in the light of the certainty of result attained elsewhere, and of the accumulated experience of many difficulties overcome. In the main, the whole question resolves itself, as I have stated above, into the practical application of common sense and ordinary reason to natural principles. One of my chiefest difficulties, strange as this may appear, is to persuade owners and engineers that it costs money to heat water, and that when once heated, it is cheaper to retain the heat than to allow it to be wasted and then spend more money to re-heat it. I am not exaggerating the matter in the least when I put it thus strongly. Against me is the prejudice born of long years of different usage, and it is frequently difficult to convince men, without doing injury to their self-esteem, that methods which they have been accustomed to use during an engineering life-time of perhaps many years, are not only merely out-of-date, but are also wasteful and extravagant.

I sometimes fancy that if the idea were more complex, if it involved a more intricate solution of an abstruse problem, it would be less difficult to impress its value on the average man. But gradually the engineering profession is being forced to a realization that one of the very easiest methods of reducing the fuel bill is the ridiculously simple one of not allowing the valuable heat-units contained in water pf condensation to escape to the atmosphere unnecessarily, but to retain them where they have been put at the expense of the man who foots the bills.

In conclusion, I would again impress upon you that we have no longer the fertility and large productive powers of the virgin soil. We have reached the stage already, where it pays well to glean the odd ears of corn that have dropped into the furrows.

THE BADGER FIGHT.

When work was over at the Berlin C.A.S.E. convention, there was ample entertainment provided—or made up in a hurry. One of these cases in point was the fight arranged for, after the smoker. There was to be a keen contest between a ferocious bull dog and a badger. This badger was brought in from outside and was confined in a box in the inner Chamber of Horrors. To see the mill one had to have a ticket. They sold at from 10c to two plunks. The doors were all locked to prevent police interference, and the dog unchained. The keeper of the badger yanked out his fighter. But the badger didn't badge. The so-called animal was a certain article of crockery, securely tied by the handle. Some of the fellows are still howling—but a few couldn't see the joke.

TORONTO NO. 1 OFFICERS.

The following officers have been elected for the ensuing year by Toronto No. 1 lodge C.A.S.E. :

Past president, W. C. Tait.
President, W. E. Archer.
Vice-president, T. D. McGhie.
Conductor, J. Sanderson.
Doorkeeper, W. J. Bigger.

W. E. ARCHER,
President Toronto No. 1, C.A.S.E.

Finan.-Secy., J. C. Tweedale.
Record.-Secy., J. W. Marr.
Trustees, A. M. Wickens, J. Brown and J. Hughes.

TESTS OF PEAT AS FUEL.

The fuel testing plant at Ottawa is to be operated under the direction of B. F. Haanel, for the purpose of experimentation and demonstration. A second producer, suitable for lignite and bituminous coal is to be installed at the plant.

The Government peat bog at Alfred is to be operated for a period of about three months to demonstrate the latest process of manufacturing air dried peat. Several thousand tons will be produced during the present season. Part of the peat fuel produced will be shipped to Ottawa for use in the peat-gas producer plant now installed, and part will be sold in the neighborhood for domestic use. The operation of the plant at the bog, which is open to public inspection, is under the direction of A. Anrep. The bog can easily be reached from Caledonia Springs, or from Alfred, on the Canadian Pacific Railway.

A cordial invitation is issued by the mines branch of the Department of Mines to all who are interested in the development of a peat fuel industry to visit the fuel testing plant in Ottawa or the peat plant at Alfred.

The invesigation of peat bogs in Canada, to ascertain their extent and to determine the quality and quantity of peat available, will be continued by A. Anrep after the operating plant at Alfred is closed down for the season.

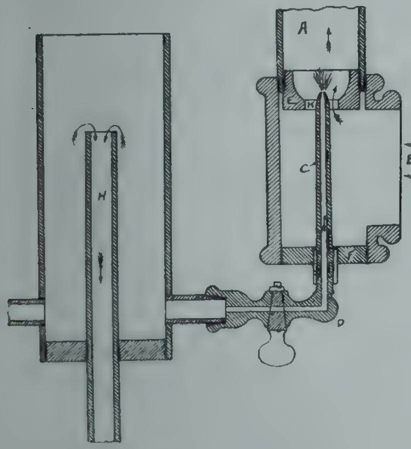
PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

A SIMPLE CARBURETOR.

By James E. Noble.

The accompanying sketch illustrates a simple carburetor for a gasoline engine. I cannot vouch for its reliability as I am writing from a description given me by a friend some time ago. It is made entirely from gas pipe and fittings—the only cock being used is a common ell gas cock. The curburetor is of the constant level type used on many stationary engines.



A Simple Carburetor.

The top of the pipe H needs to be about ⅜ of an inch below the top of the spraying nozzle. The air opening at K should be about one inch in diameter and the end of the spraying nozzle C ought to be flattened out so that there is a slot about 1-32 of an inch wide. B is the air supply; F is made from a plug; E is made from a bushing; A is the pipe to the engine, and H is the overflow pipe. I understand that the carburetor was originally made in order to alter the governing of the engine from hit-and-miss to throttling for the purpose of making some comparative tests. It would be interesting to hear from some of your experienced gas engine readers and to get their opinion as to whether it will give good results at various speeds and loads.

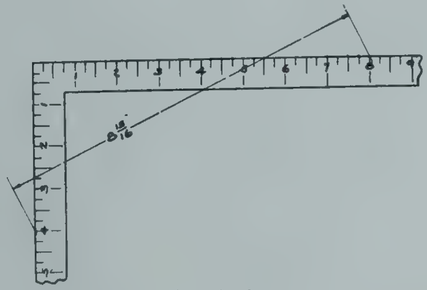
HORSE POWER.

Old James Watt established the term "horse power" in order that he might have some basis of comparison of the power developed by his engines. He measured the work done by a heavy London draft horse of the Clydesdale or similar variety during short intervals by observing the weight it could lift against gravity, the horse walking on the ground and pulling horizontally on a rope led through pulleys, so that the weight rose vertically. The unit horse power, so established, was 550-foot pounds of work per second, or 33,000 foot pounds a minute—that is 33,000 pounds raised one foot in a minute, 330 pounds raised 100 feet or a pound raised 33,000 feet a minute. But whereas few horses could do that amount of work for more than a few seconds together, a one horse power engine will go on producing that amount of work indefinitely so long as it is supplied with steam.

SIZE OF PIPE.

By W. Oelschlager.

An easy method to ascertain the size pipe required to unite two pipes into one, so that the one shall have the same area as the two. Say it is desired to unite a 4-inch and an 8 inch, take an ordinary carpenters' square, measure diagonally across with a rule from the 4 inch mark on the one blade to the 8 inch mark on the other blade, which will be about 8 15-16 inch or 9 inch pipe.



Size of Pipe.

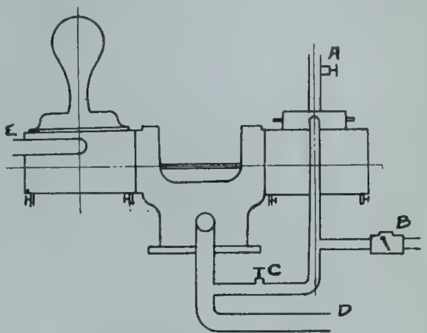
SELF-CONDENSING PUMP.

By J. Vincent.

This description is of an idea I recently applied to a small 6×6×4 Marsh steam pump for condensing its own steam.

Start the pump by opening valve A with valve C closed, which permits the exhaust to pass out through the check-valve B which opens outward. Immediately the pump lifts water, open the valve C and the suction will draw the exhaust into the water and be condensed. The check valve B is closed by the air pressure.

With a gauge on the delivery pipe E, showing a pressure of 25 lbs., and valve C closed, I can increase that gauge pressure from 5 to 10 lbs. by opening valve C, without changing the amount of steam at the throttle.

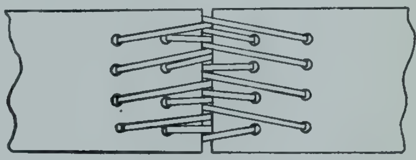


Self-Condensing Pumps.

BELT LACING

By James E. Noble.

Wire lacing for belts is extremely good, as it has numerous advantages over other types, viz., elasticity, belt can be laced quickly, practically noiseless operation, and small cost, for considering everything, it costs less than most lacings.



A Good Joint for Small Belts on small Pulleys at High Speeds, but All Right Anywhere.

In lacing with wire it is a good idea to insure the ends of the wire being forced into the belt, as otherwise, a cut hand might result should an attempt be made to shift the belt by hand.

The ordinary rawhide lace is also good. A favorite method of lacing with rawhide is the hinge-joint; for joints of this nature have been known to run for several years without trouble. Another wrinkle, when putting up new belts, is to have a short intervening piece at the joint. After a few days operation, the belt will have attained such a slackness that the piece may be removed, and the belt will be then found to be at the correct tension.

It is said that a tension of 35 pounds per inch, exclusive of load, is quite sufficient to prevent belt slipping or creeping as it is sometimes called. A belt might run with practically no slip with a light load, and yet slip considerably with a heavy one, if the tension were not correct.

Much belt trouble is occasioned by the use of pulleys too narrow for their belts. In many cases, the pulley is exactly the same width as the belt. This should not be; the pulley should be wider than the belt whenever possible.

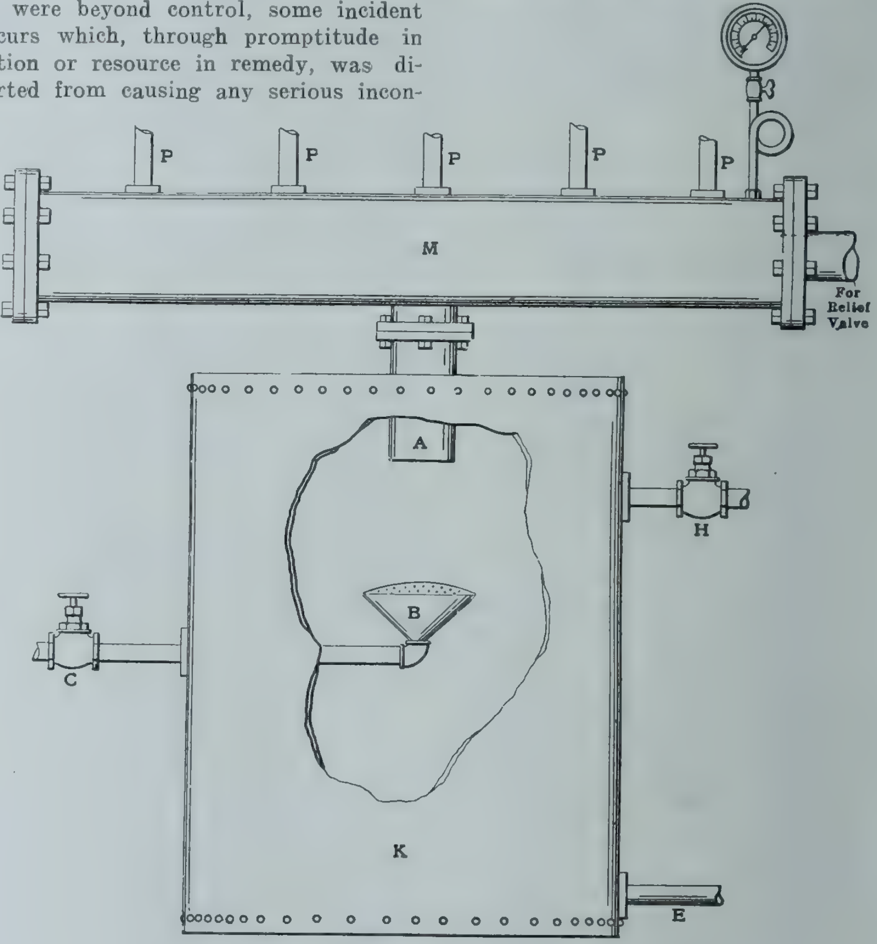
More caution should be exercised in the use of many of the so-called "belt dressings," which are often home-made mixtures of castor-oil and resin or some such combination. No matter how slack, dirty, greasy, wet, etc., a belt may be, use dope, appears to be the watch-word of most engineers. If the belt is large enough, and hugs the pulley closely, there should be very little slip. A simply experiment shows this. Wash and dry your hands thoroughly, and slide them along a smooth polished surface, such as glass, and it will be noticed that the drag is considerable. A belt behaves similarly. If it is clean and large enough to carry the load, and if the tension is correct, no belt dope should be required. Of course, a little belt dressing to keep the belt soft and pliable, is essential, but it should be a dressing made by a reliable firm.

SIMPLE HOME-MADE CONDENSER.

By James E. Noble.

A condenser in its simplest form which I designed for a correspondent of a technical paper is here shown. It can be used on the returns in steam heating systems or for any similar purpose. Although in most steam heating systems the only thing required is a receiver tank to collect the air and water which in turn is pumped out by a vacuum pump, this pump will maintain a constant vacuum of any desired degree in the returns. However, for the man who will have a condenser, nothing more simple then the one here shown can be devised.

K is a vessel of any desired shape. M is the receiver header into which all the different returns enter. The header is connected to the condenser proper by the pipe A. Valve C is for the cold injection water, and B is a perforated rose which sprays the water over the entering steam. The pipe H should be connected to a city water main or other supply, and can be used should the condenser get too hot through stoppage of injection water or any other reason. A suitable relief valve should be attached to the header so that mains could not possibly become flooded through stoppage of the air pump or other cause. E is the connection for the air pump.



Simple Homemade Condenser.

INCIDENTS IN CENTRAL STATION PRACTICE.

By J. A. S., Newcastle.

It is perhaps a very good thing that the life of the engineer in charge of a power house is varied by incidents which are sometimes outside the ordinary routine of practice. In one respect the breakdown of any portion of the plant whether mechanical or electrical not only throws a good bit of work upon the engineer in charge of it, but unless the cause of the affair can be proved to be beyond the control of the maintenance staff, there is a certain amount of stigma attached to any interruption of supply. It is, however, the pride of the engineer if, owing to circumstances which were not foreseen, or were beyond control, some incident occurs which, through promptitude in action or resource in remedy, was diverted from causing any serious inconvenience to the consumers of the electricity supply undertaking. It may be useful to make a few notes of incidents which have actually occurred in electricity supply power houses in order to indicate to some slight extent some of the troubles which the engineer in charge of the plant has to face.

It is not usual that trouble is looked for in the fuel which is used, and yet if an inadequate system of storage is adopted, it is quite possible that coal may become, not only an expensive thing to handle, but a source of positive danger to the station. An instance in support of this statement may be remarked upon. In one case a serious fire occurred in the coal bunkers which was ultimately traced to a lack of ventilation in combination with other causes. At the time when the coal was brought to the power house for storage it was wet and the bunkers were situated above the boiler house, so that a gravity feed to the boilers could be utilized. It is, therefore, evident that the bunkers would always be hot owing to the heat from the boilers beneath, and unfortunately they were not very well ventilated. Owing to the fact that it was the policy of this particular supply undertaking to keep a considerable storage of coal for the purpose of minimizing the effect of variation of prices, and also to the fact that the boilers fed by the particular bunkers in question were down for prolonged alterations and repairs, the coal was allowed to stand unused for far too long a time considering its condition. Chemical changes, assisted by the heat and moisture present, had taken place in the heart of the coal and caused spontaneous ignition. The result was that at its centre the coal in the bunkers got red hot, smoked and finally caught fire.

In order to get over the danger which threatened the destruction of the building due to the possible cracking of masonry and warping of the steel structural parts of the building, a hose was kept playing upon the coal heap in question, and the bunkers were flooded. As soon as the fire was put out, which was rather a troublesome matter, the coal was removed on to the firing platform in front of the boilers for use as speedily as possible, and in future damp coal supplied to the station was not allowed to stand for any longer a period than was possible.

That this is not altogether a detached incident is shown by the fact that a somewhat similar case occurred in an old power house of early design, where the coal was heaped around an upright wooden beam supporting the roof. This coal heap, owing to similar causes to those mentioned above, caught fire, and for a time there was considerable danger that the upright beam would be destroyed and the roof of the boiler house would collapse. Fortunately the trouble was discovered in time and the ignited coal heap removed.

Most of the trouble, however, in a power house occurs in the engine room, unless the boilers are of a very inefficient type or badly maintained. Running machinery has, however, a peculiar facility for going wrong at unexpected times, and it is. therefore, the duty of the engineer in charge to watch, not only the performance of the drivers and greasers under his charge, but to go further than this and keep a careful watch on the plant on his own account. Too much reliance upon the work of subordinates invariably leads to disaster. A few instances of engine room accidents may be of service in this connection. In one instance, a shut down was narrowly averted which was caused by a hot dynamo bearing, which was in its turn due to the faulty replacement of an oil ring. These rings had been removed for cleaning, and each ring consisted of two semi-circular halves hinged together at one end and fitted with a spring clip at the other. In replacing the ring in the oil box, which had been cleaned out and the bearing overhauled, sufficient care had not been taken to see that the spring clip bit properly, and as a result the ring had afterwards sprung open and consequently hung loose in the oil, with the result that the upper portion of the bearing was not lubricated at all. As soon as the trouble was discovered the inspection hole covers were lifted and the machine kept running, as if it has been shut down the bearing would probably have seized, and probably loss of time would have taken place in getting it to run again. Oil was poured in freely at the inspection and hand holes of the bearing and run out again at the gauge cocks, while, in order to facilitate the cooling, damp rags were placed round the case of the bearing. By this means trouble was averted, and when the bearing was fairly cool, the faulty ring was made to clip properly. In future it became the practice of the engineer in charge to inspect all the oil rings before starting up his machines.

Some stationary engineers are too prone to put undue trust in their machines owing to their good behaviour, and two instances may be mentioned of the way in a machine which, if fairly treated, would have done its work all right, was thrown out of action, owing to its good qualities being presumed upon. The first is a case of a two-pole motor generator which was used to transform down a power voltage on the station busbars to a lower potential for local lighting. Owing to extensions in the lighting system the load had gradually crept up on the machine, until finally it was overloaded for a prolonged period. This eventually caused the armature to heat and swell and finally it fouled the field magnets sufficiently to cause the insulation to rub over in certain places and to cause an earth between the armature and magnets. Fortunately this made the overload circuit breakers come out thereby shutting the machine down and preventing further trouble. The armature had at once to be taken out and the spare put in place, and after the field magnets had been emeried over in the clearance space in order to remove stray copper due to the fault, the armature circuit breakers were "set down" or adjusted to operate on a smaller load and provision was made to take over a portion of the load on to another plant. With these alterations the motor generator resumed its previous functions of supplying the local lighting which it accomplished in a satisfactory manner. The other instance occurred on an alternating current system of supply. The engineer in charge was blessed with an alternator which was of the revolving armature type of very strong construction, and the machine took excessive loads in paralleling so well that the engineer was not particularly careful as to the way in which he used the synchronising gear. The inevitable result followed. After many repeated bad parallels the machine, unfortunately, gave up hope on the matter and one of the armature coils became displaced. As the clearance between the armature and the field was not great this coil, in revolving, nearly stripped all the field coils and the amount of trouble and expense that was involved in replacement had the effect of instructing the engineer as to the arguments against misusing the plant.

A rather curious incident which occurred some considerable time ago in connection with a patched up set, consisting of two shunt dynamos connected in series in order to double the voltage of supply, may be mentioned. The shunt or field coils were also connected with each other. These machines were used constantly throughout the week, with the exception of Saturday afternoon and Sunday of each week, and it was for a considerable time a source of great wonderment to the station staff that on Monday mornings great difficulty was experienced in starting them. The machines appeared to have characteristics which were quite human. In order to get them to go the only thing that could usually be done was to short circuit the shunt terminals. After a time it was discovered that the cause was due to the fact that the machines had pole pieces made of very soft iron which became demagnetised over the week-end.

ASBESTOS PACKING.

In answer to Woolen Mill Engineer re asbestos packed cocks, I would advise him to secure some twisted asbestos wick about 3-16'' diameter and drive into the grooves in cock with a suitable tool. I have been experimenting with different packings on these cocks for some time, and have tried the method as advised, by A. F. Moray. I have also had some success by pouring the grooves with babbitt metal, but have adopted the method advised above, as I find that they last longer packed that way without leaking, than any other method I have heard of The particular kind of asbestos wick that I am using is slightly coated with graphite, and is extremely hard. I find that the harder it is, the better job it makes, as it will not slip when being driven in. —W. G. Walters.

BOILER FEED.

In reply to the question asked re boiler feed—supposing I have 4,000 lbs. of water to feed to a boiler in a given time, will the water last longer if the pressure is 100 lbs .instead of 60 lbs.?—this can be answered in the affirmative, supposing his water is at the temperature of 70 degrees Fahr. the factor of evaporation of water at 70 degrees Fhr. and 60 lbs. pressure (by gauge), is 1.178, and for a gauge pressure of 100 lbs. is 1.187. Now we will × 4,000 by the different factors and see what will be the results

$$4,000 \times 1.178 = 4712.000$$
$$4,000 \times 1.187 = 4748.000$$

the results obtained by this shows that with the 100 lbs. pressure the water will last longer than with the pressure at 60 lbs., and also illustrates the economy of using high steam pressure.—W. G. Walters.

REFRIGERATION DEPARTMENT

BRINE STRENGTH AND CAPACITY OF PLANT.

By Lewis C. Reynolds.

A reader asks how to calculate the amount of salt required to bring the strength of the brine in an ice tank from 60 degrees to 90 degrees on the salometer. The size of the tank is given as 20 by 14 by 18 feet deep. In answering the query the quantity of brine in the tank is calculated as 1,680 cubic feet, which is the volume of the tank. However, as the cans displace their volume of brine, allowance must be made accordingly. From data taken on a number of installations it will be found the the ice cans occupy from 40 to 50 per cent. of the tank, the figure depending somewhat on the capacity of the tank in water per minute, 60 feet requires nearlly 3 horse power, theoretically, and as pumps are not economical in steam consumption this might amount to about 500 pounds of coal per day. The distilled water flows from the condenser to the reboiler and needs here, as it has been cooled down 70 degrees more than necessary,

$$120{,}000 \times 70 = 8{,}400{,}000$$

B.t.u. of additional heat. To supply this,

$$\frac{8{,}400{,}000}{960} = 8750$$

pounds of live steam will be required, at an expense of about 1,100 pounds of coal per day.

The waste of coal due to the excess of cooling water used on the steam condenser counts up to about 1,600 pounds of coal per day, and must be considered a total loss, as cold storage is connected with the ice plant, and all the distilled water from the exhaust steam cannot be frozen. If the overflow from the ammonia condenser could be used and only an adequate amount of it turned on the steam condenser, so as to raise the water leaving it to 180 degrees, a saving of more than a ton a day could be effected.

Water coming from the steam condenser was used for thawing the ice cakes from the cans in two tilting and sprinkling devices. These did not work well, as the sprinkling water was too cold. Eight or nine 300-pound cakes had to be dumped by each outfit every hour, and whenever a can did not release its cake on time the ice pullers would help with kicks, clubs and crowbars. The ice in the storeroom was clear and almost free from cores, but I noticed a number of cakes which showed signs of salt water, due to leaks in the cans which most likely were caused by abuses on the dumping stand.

Considering that this negative result had been obtained at the expense of about one ton of coal a day, it will be evident that the reasonable use of cooling water on the steam condenser is an important item in the management of an ice plant.—Power and Engineer.

MODERN REFRIGERATING MACHINE.*

By H. D. Pownall.

The value of mechanical refrigeration in such institutions as hospitals, sanitariums, morgues and the saving of life and health by the more general distribution throughout the year of fresh, wholesome foods cannot be estimated in money value; neither can its worth in the iron and steel industries, in chemical industries nor in the added comfort to humanity be computed. Its incalculable influence in the improvement of manufacturing and social conditions is gradually lost from sight, inasmuch as its benefits come gradually and are unconsciously accepted.

There is probably no other branch of engineering less thoroughly understood than that of refrigeration, this being partially due to the lack of printed matter or text books relating to this subject. And the lack of printed information is in a measure attributable to the fact that it is a very costly procedure to secure accurate data relative to this science. In electricity or other lines of engineering, a complete unit may be easily tested for both efficiency and characteristics at a moderate cost before shipment. An accurate test could not be made upon a refrigerating plant of any size for less than $1,000, and the data secured from this test in the majority of cases would be applicable to the one plant only.

Up to the present time, notwithstanding the wonderful strides which have been made, the various engineering bodies have failed to reach any definite conclusion as to what shall constitute a standard tonnage basis; that is, to establish a definite unit of refrigeration. The various manufacturers of such machinery therefore rate their product according to their own judgment.

Principles of Refrigeration.

Mechanical refrigeration depends upon the now well-known fact that fluids in changing from a liquid to a gaseous state absorb heat, which, in turn, is given off on again resuming the liquid state. These different states are brought about by variation of pressure, due to the operation of a vapor pump (or compressor), which compresses or elevates the pressure of the gas to a point which will permit of its liquefaction. The heat produced by compression is removed by water flowing over or through a condenser, it being necessary to remove 1 B.t.u. in the condenser for each B.t.u. absorbed by the gas in evaporating, plus a slight addition due to the heat caused by compression and by friction of the gas in the piping system.

The liquid flows from the condenser to a receiver and from the receiver through a controlling valve erroneously called an expansion valve.

The pressure on the condensing side when using ammonia as a refrigerant varies from 125 to 200 lbs., dependent upon the size of the condenser and upon the temperature and amount of water available for condensing purposes. The liquid, during refrigeration, first flows as a liquid through the controlling valve, where its pressure is reduced from the condensing pressure of approximately 175 lbs. to that of the refrigerator, or about 15 lbs. The temperature of the liquid flowing to the controlling valve is about 90 deg. F. and after expansion is about 0 deg. F.

This reduction in the temperature of the liquid ammonia is caused by the evaporation of a portion of the liquid, which, owing to its latent heat, cools the balance of the liquid to the refrigerator temperature of 0 deg. Theoretically under the above condition about 18 p.c. of the liquid is converted into gas at this point in cooling the remaining volume to the temperature of the balance of the liquid in the refrigerator, the variation in the two pressures being controlled by the rate of flow through the liquid valve and by the removal of the resultant gas with the compressor.

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* Read before Society of Mechanical Engineers.

The refrigerating fluid is contained in coils of piping or in cylindrical vessels, similar to return tubular boilers. In an ice-making system these coils or cylindrical vessels are immersed in a brine solution, this brine being caused to rapidly circulate around or through the piping system. The brine, being warmer than the ammonia, causes the latter to boil or evaporate. Ammonia boils at 29 deg. F. below zero at atmospheric pressure. During this process the refrigerating agent absorbs from the brine a certain amount of heat which is conveyed to the compressor, the resultant gas being again elevated in pressure to a point sufficiently high to permit re-liquefaction; thus a continuous cycle is formed, consisting of three functions, performed by the following parts of the equipment: 1, the compressor, 2, the condenser, 3 the evaporator.

Refrigerating Agents.

Many different volatile fluids are adaptable as refrigerating agents, but those which have proven most practical are anhydrous ammonia and carbonic anhydride. Although the same principle underlies the use of all such fluids, their physical properties vary and consequently demand different treatment to produce the best results. In so far as the user is concerned, these differences result in the varying volume of fluid to be circulated and in the variation in condenser and refrigerator pressures peculiar to each individual agent. These conditions, in turn, determine the dimensions and strength of apparatus used. The chemical action of the various agents demands the use of somewhat different materials in the construction of the various parts of the equipment with which the fluid comes in contact. At the present time ammonia leads the list in popularity, and in fact, has almost superseded other refrigerating agents.

The ordinary working pressures of the ammonia compression or absorption system are from 15 lbs. on evaporating side to 220 lbs. on the condensing side, while that of carbonic anhydride is about 300 lbs. on the evaporating and from 950 to 1,250 lbs. on the condensing side. It may be safely asserted, however, that in the United States there are now 199 ammonia compression plants sold to each carbonic anhydride system.

REFRIGERATION CONDENSER DIFFICULTIES.

By W. G. Walters.

The connection between steam engineering and refrigeration is on a par with that existing between the former and electricity. Both refrigeration and electricity in their practical application to the service of mankind demand the highest engineering skill; and it goes without saying that the engineer who is an expert in either of these widening lines of progress will receive the highest pecuniary return for his services.

That buildings will soon be cooled and ventilated by artificial means is assured from the high efficiency now attainable by mechanical reftigerating machines. This makes it desirable that the engineer should become as thoroughly posted as possible regarding the principles and operations of the various mechanical refrigerating systems now in general use, and watch future developments so that he can keep up with the times, and be capable of filling any position when the opportunity presents itself.

As the subject of condensation offers a wide field, a short discussion on that subject would be to the point. From the fact that the pressure against which the compressor works, depends almost entirely on the temperature of the condensed ammonia, it follows that the lower that temperature is kept the less will be the wear and tear, and also there will be a diminished steam consumption resulting in a smaller coal bill. The quantity and temperature of the condensing water are therefore points that require careful consideration. It should be the aim of every engineer in charge of a refrigerating plant to condense the ammonia to as low a temperature as possible; but where a manufacturer depends on city water for condensing purposes he cannot economically cool the ammonia to a lower temperature than 65 deg. to 70 deg. Fahr. If the supply of water is increased so as to reduce the ammonia to say 68 deg. Fahr., extra expense is incurred which would not be warranted by the resulting increase in the refrigerating efficiency, unless this water can be used for other purposes, passing through the condenser. In the case of a packing house, this is possible. If the temperature of the water supplied to the condenser is in the neighborhood of 50 deg. Fahr., as for example, deep well water, it will not be difficult to reduce the temperature of the ammonia to 62 deg. Fahr., and to liquefy it. A cause of great loss lies in the fact, that although considerable expense is often incurred in order to condense and cool the ammonia to the lowest possible temperature, the importance of arranging to maintain that low temperature until the ammonia reaches the refrigerator, is entirely ignored. The receiver and a considerable length, if not the whole of the piping, through which the ammonia must pass on its way to the refrigerator, are as a rule, situated in the boiler and engine rooms exposed, as a rule, to a high temperature. In this way the temperature of the ammonia is often raised as much as 20 deg. higher than when it left the condenser before it reaches the refrigerator. As this increased temperature means a loss of from ¼ to 1½ tons refrigerating power per 24 hours for 65 ton machine, it would seem as though it would be advantageous to have the piping covered with a good non-conducting material, in order to fully take advantage of the beneficial results derived from a liberal water supply to the condenser and thus prevent an unnecessary waste.

Another source of needless loss, one which has a great effect on refrigerating efficiency, lies in the superheating of the ammonia gas, which occurs when the pipes through which the ammonia passes between the refrigerator and the compressor are not protected. Some argue that it is absurd to go to any expense to prevent the gas from absorbing heat, as it must become heated anyway on entering the compressor. If consideration were given to this point it would at once be seen that the higher the temperature of the gas is before entering the compressor the greater will be the volume of a given weight, and therefore the compressor, although handling the same volume will not handle as great a weight. As the refrigerating efficiency of a machine is proportional to the weight circulated it is at once seen that the higher the temperature of the gas before it enters the compressor the smaller the refrigerating efficiency of the machine will be, the suction pressure being the same in both cases.

Another source of loss arises in connection with refrigeration. In compressing the gas from a low to a high temperature considerable heat is generated which is transmitted to the compressor cylinder and all its parts. Some machines are equipped with a water jacket to keep the cylinder cool, but as this does not reach to any extent the piston and valves, oil is injected during the stroke. The oil vapor sometimes mixes with the ammonia gas and passes through the oil trap into the condenser where it partially condenses and is carried with the liquid ammonia into the expansion pipes or refrigerator coils, where after a time it forms a thick coat. This coat of oil if allowed to accumulate and remain acts as an insulator and prevents the cold ammonia from coming into contact with the pipes, thus incurring a considerable loss.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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ONE BOILER-POWER.

At the spring meeting of the American Society of Mechanical Engineers held in Atlantic City, Prof. Wm. T. Magruder, Ohio University, Columbus, read a paper on "Two Proposed Units of Power." The term "boiler horse power" has been variously defined at different times and the value of an "evaporation unit" has increased with each change in the steam tables, so that what is intended as a standard is not only indefinite but confusing. As the object of a boiler is to absorb heat energy obtained from the potential energy of the fuel by combustion and to transfer this energy to a volatile liquid for convenient use in a heat engine or for other thermal purposes, the use of the term "boiler horse power" is a misnomer, especially as the energy for every boiler is measured in heat units before reduced to boiler horse power. To measure the power of a boiler plant in millions of thermal units would not be practical, so the author suggests the adoption of a unit known as a "boiler power," which by definition is equal to 33,000 B.t.u. delivered per hour by a boiler or heating main or added per hour to the feed water of a boiler or to the water of a hot water heating system. The adoption of this term should simplify the whole subject, as the unit will remain constant.

Rapid introduction of gas engines using blast furnace, coke oven or producer gas has led the author to suggest the adoption of a unit to measure the heat energy of gaseous and liquid fuels. This new unit is to be 10,000 B.t.u. of heat energy delivered per hour by the fuel under standard conditions of temperature and pressure and is called a "gas power." That number of heat units was chosen, as it represent the average required to develop a horse power of mechanical energy in the best gas engine practice to-day.

Written discussion on this paper was submitted by Prof. William Kent, who was chairman of the Boiler Test Committee of 1884. The unit now proposed was one of those rejected at that time, 33,000 heat units per hour. The standard then adopted is equivalent to 33,305 thermal units per hour, and is so near to the one proposed by the author of the paper and has been the accepted standard so long that it should not be changed now without strong reasons. He declared, however, that there is good reason for changing the figures used in expressing boiler performance on a heat unit basis, and the factors of evaporation used for converting the evaporation under any stated condition into equivalent evaporation from and at 212 degrees F. This is because the old steam tables based on Regnault's experiments are known to be slightly in error and more accurate tables are now available, that is, those of Marks and Davis. By an example he showed the difference arising from the use of the two tables to be only about 0.04 per cent. The discusser prefers Marks and Davis' tables to Peabody's, and will use them as the basis of tables of the properties of steam and of factors of evaporation in the next edition of his Mechanical Engineers' Pocketbook.

H. G. Stott supplemented the paper and suggested perpetuating the name of a great enginer by calling the proposed unit a Thurston. He also suggested making the unit a somewhat larger one than the one proposed by the author, or the one at present the standard, calling it 34,120 B.t.u. per hour the unit, making it a multiple of the kilowatt-hour.

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C. A. S. E. EXHIBITORS' ASSOCIATION.

The recent convention of stationary engineers at Berlin shows the excellent opportunity afforded for firms who manufacture or deal in power plant equipment and supplies to get in close touch with the engineer. Invitations were sent out to manufacturers and engineers in the towns near Berlin, and a large number availed themselves of the opportunity to see first hand the modern power plant apparatus being placed.

For the manufacturer of power plant apparatus it affords him the opportunity of meeting engineers in a combined social and business way, not possible under any other circumstances. Here at a minimum cost he extends the hand of good fellowship to the engineer and increases the bond of friendship that should exist between the supplyman and the engineer. In this way both engineers and the craft are benefited.

The community of interest among engineers, and among manufacturers of and dealers in power plant apparatus, has been recognized and the spirit of co-operation has resulted in a better understanding between engineers and supplymen. The engineer can examine the various articles assembled under one roof and the supplyman on the other hand is saved the large expenditure formerly necessary to acquaint engineers with their lines of supplies.

It will therefore be clearly understood why the number of exhibitors increases each year. The next convention will be held during the last week of July, 1911, at Stratford, Ont., when it is hoped and expected that the number of exhibits will be largely in excess of this year. The co-operative feature should appeal to manufacturers of power plant apparatus and arrangements should be made to exhibit at Stratford next year.

SAVING HEAT UNITS.

The saving of a little hot water which formerly went to waste resulting in the saving of thousands of dollars should make engineers and manufacturers think carefully of what the attention to seemingly minor things, means. Allowing the hot drips from a heating system to run into the drain looks like a small thing, but is it?

If a plant is located on a water front try throwing a bushel of coal into the water each day. Figure what the waste will mean in a year. You will then have an idea of the fuel that is being thrown away by hot drips being fed into the sewer. Mr. Peilĕr's paper in this issue gives a clear idea of what saving of waste means and it should be perused with a great deal of interest.

◆

USE OF SUPERHEATED STEAM.

The use of superheated steam in engines and turbines has been such that its behavior can now be predicted with more or less certainty, says Power. At the present writing, no engineer can successfully plead ignorance as an argument for or against its use. It is now pretty clearly understood that the economy resulting from the use of superheat is due to the prevention of condensation both in steam pipe and cylinder, rather than to any great increase of efficiency in the steam itself. Nothing succeeds like success—that is, nothing is so good a preventive of cylinder condensation as steam which is initially dry or slightly superheated. The exact amount of superheat necessary to prevent condensation varies with circumstances but it is probably from 5 to 10 degrees of superheat for each one per cent. of moisture present at cutoff.

Current practice favors the use of an inclosed superheater connected to the boiler, rather than the independent type. Where a superheater is placed in the passageway of hot gases without interfering with the natural heating surface of the boiler, there will be no loss of efficiency in the latter; in fact, there will be sometimes a slight gain.

Experiments both on stationary and locomotive engines show a possible economy in steam consumption of from 15 to 20 per cent. and a net heat saving of from 10 to 15 per cent. with a comparatively low superheat of from 100 to 150 degrees.

The engine economy is most favorably affected in those engines which are particularly subject to initial condensation and wet steam on account of low speed, poor proportions, etc. Locomotive engines are particularly susceptible to improvement in this respect because of the large amount of condensation which is ordinarily present when saturated steam is used.

Experiments made thus far show a continual improvement in tne economy of locomotives as the amount of superheat is increased up to 180 degrees. The maximum would probably be higher for locomotives than for stationary engines, due to the causes mentioned. With a superheat of from 50 to 150 degrees at the throttle, little trouble will be experienced from the increase in temperature. Additional care must be used in lubricating the valves and pistons of the engine and a high grade of cylinder oil must be used.

Troubles will be experienced with the pumps attached to the steam line unless special attention is paid to the packing and the lubrication.

When superheat of a greater degree is used, there will be trouble, and plenty of it, both in the boiler and engine room, unless the piping and machines have been especially designed for thigh temperatures. Cast-iron fittings become more or less unreliable at temperatures of over 500 degrees Fahrenheit and some grades of iron are brittle and dangerous at these high temperatures. Ordinary gaskets leak and blow out. The packings of the pumps rapidly deteriorate and there is trouble with the lubrication on both engine and auxiliaries; serious cutting of slide valves frequently results, and metallic packings become necessary on the piston rod. If there is much fluctuation of temperature, great trouble is experienced with the piping on account of uneven expansion and fittings are sprung and sometimes broken.

Our advice to anyone who contemplates using high degrees of superheat in an old plant is most emphatically "Don't," because the disadvantages will more than offset the gain in economy. Like most panaceas, superheat must be used with discretion and is not a cure for all the evils in the calendar. It is doubtful if temperatures of over 600 degrees are advisable in any plant, but when a new installation is made with piping, fittings and gaskets designed for high pressures and temperatures, the result is much more satisfactory than when an attempt is made to graft new ideas onto old equipment. Remember that a moderate superheat, 50 to 100 degrees, can be employed without serious difficulty and will pay a better return in proportion to the trouble than higher degrees, and that the high temperatures are only desirable when the whole equipment is designed especially for their use.

◆

CONSULT THE ENGINEER.

Proprietors of power plants should have confidence in their engineer. They made a mistake if they place orders for power equipment or supplies without consulting him. He has ideas about running a plant that are worth having. As a rule he is an intelligent individual, kept informed on modern developments and best practice by the careful perusal of books, technical journals and by rubbing shoulders with brother engineers in discussions on questions of interest at engineers' meetings.

The annual convention of the C.A.S.E. illustrates how the engineer keeps up with the times. Various manufacturers of power apparatus displayed the latest designs of equipment where the engineer could see first hand, modern devices. Papers were read by men high up in the profession, all with the object of keeping up with the times.

An engineer is therefore capable of giving expert advice on matters concerning the equipment or layout of the power plant. He will be able to suggest things worth taking into serious consideration. It will pay all proprietors of power plants in laying out a new plant, buying new equipment or making changes to the power plant, to do as many now do, consult your engineer.

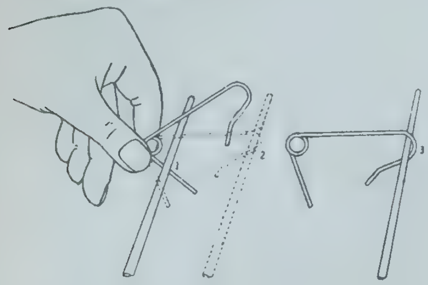
NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

TRILL INDICATOR HOOK.

Patent Applied for.

Engineers understand the difficulty and oftentimes the danger there is in connecting the indicator to standard on crosshead, especially where an inexperienced engineer attempts to connect up on a high speed engine. Not only is there risk for the engineer, but there is danger that the indicator may be wrecked.



Trill Indicator Hook.

Numerous devices have been designed in the past, so as to render the making of this connection easy. These while they have been more or less successful, have always been cumbersome and expensive.

The above cut shows what the Trill Indicator Company have done in this line. This is simple and efficient, and renders the operation of connecting to standard on crosshead a very simple matter, even though the engine may be running at 400 or 500 r.p.m.

It is operated as shown in the illustration. Hold the loop of hook between thumb and finger, allowing the pin on standard to strike the straight part of hook when it is within about one inch of the end of its travel, and connection is made instantly without danger to instrument or operator.

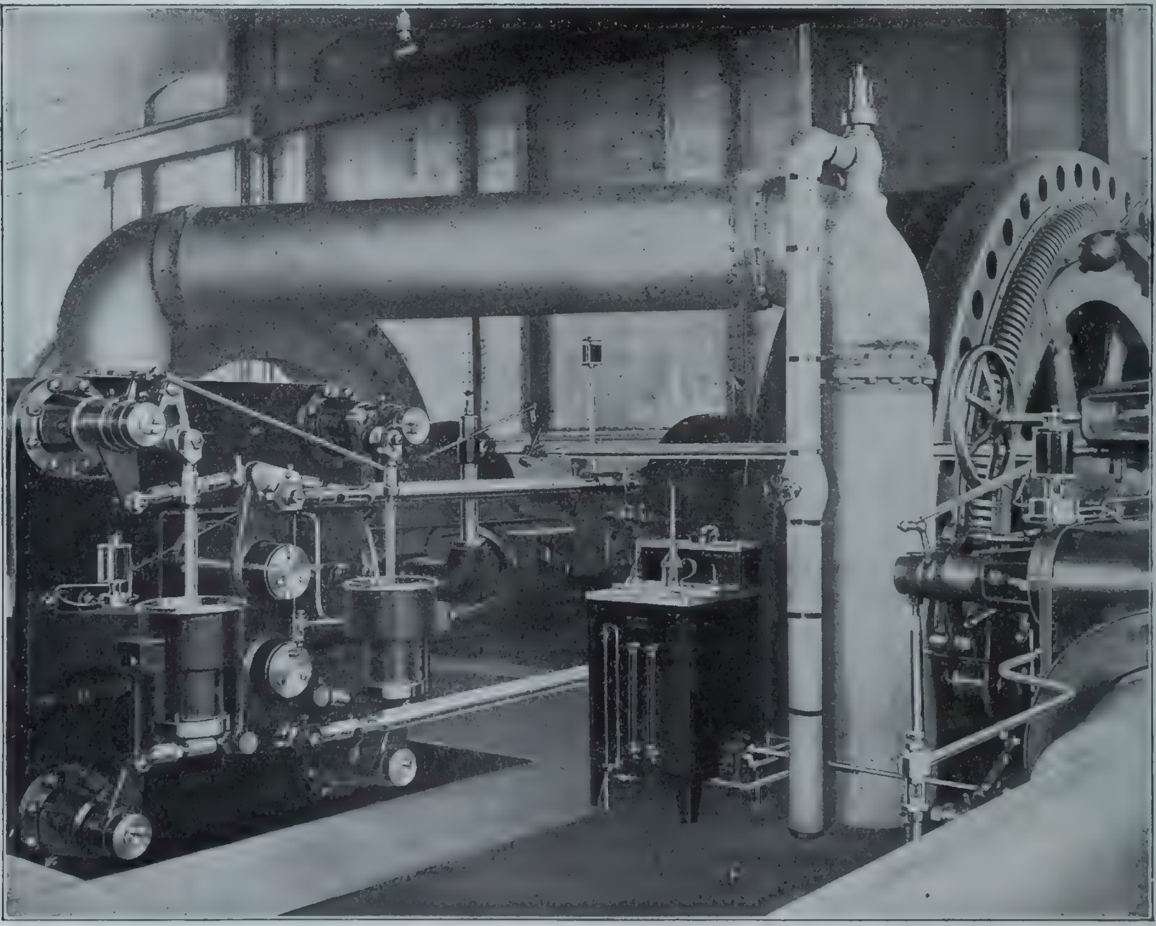
The hook is manufactured by the Trill Indicator Co., Corry, Pa.

POWER HOUSE LUBRICATION.

The detailed design of the modern power plant has been carried out with extreme care and, for the most part, regardless of expenses that look towards freedom from general shut downs in case of accident. Effort has been made in all directions to so place the piping, valves, switch board connections, etc., that any arrangement of groups of power units, or sub-groups, could be made, and the steam exhaust and electrical connections carried out—enabling the station to send out current for power in the face of accident to any portion of the station apparatus.

This has been accomplished by the employment of bus bars on the switch board, allowing of cross connections independent of units that are out of commission, by means of independent atmospheric exhaust connections—independent condensing units—by loop piping from the boiler, and in various other ways have these details been worked out to obviate the interruption of service.

Yet in the face of this careful subdivision of the essentials of a plant, we find that the oiling systems are usually put in so that the system is common to all the units; making it im-



Power Plant Lubrication.

possible at times to lubricate the machinery, due to failure or stoppages occurring in some of the pipe lines which are common to all units. The large storage reservoir, the long header lines carrying oil to and from the engines, have been known to cause a complete shut-down of the plant. It is true that most instalations have filters in duplicate, steam pumps necessary for handling the oil in duplicate, but other features have been overlooked that would lead to trouble.

In harmony with the sub-division idea of instalation, the Richardson-Phenix Co., of Milwaukee, are putting out a line of unit oiling systems, of which they are building the filter, sight feeds, the necessary pumps, and a line of very clever pipe fittings, known as "Union-Cinch," for piping up the oil lines on the engine. Their system of lubrication obviates the necessity of connecting two units into a common pipe line, or having any storage reservoirs or drainage tanks in the basement or over head; and consequently there is no necessity to run any pipe lines to these points. The filter is intended to be placed on the engine room floor, where it is convenient for the engineers and oilers to take care of and watch the operation of the apparatus. There is a double-ended pump which is attached to the filter and arranged to be driven from some part of the valve motion on the engine. There is a coupling provided for the driving connection of this pump, which may be disconnected easily, and a little handle is provided so the pump may be operated by hand at any time. This pump is a very sturdily constructed affair, handling the dirty oil at one end and clean oil at the other. The valves and details of construction are worked out in such a way as to enable it to handle dirty oil successfully and continually, requiring no attention at all from the operating forces. One end of this pump is connected to a drainage receiving well, to which all the drains over the engine are piped. This well is of cast iron, intended to be placed in or under the floor, and is provided with a substantial cap, covering a large, removable strainer, catching the greater part of the foreign matter draining away from the engine bed and bearings. The pump takes this dirty oil from the receiving well and puts it into the upper back chamber of the filter, where a heating coil is provided for warming up the oil to assist in the separation of foreign matter and water—if there be any present. The overflow from this chamber is gradual, although the incoming oil may come in irregular quantities. This chamber is provided with a settling basin in the base for retaining such foreign matter as will settle at this point.

Flowing from this chamber, the oil enters a central separating chamber and goes down through a central tube, rising up through water, where the separation of dirt is carried on to a still further extent. This chamber is provided with a gauge glass, so that the amount of water and oil may be observed, and is also provided with an automatic overflow so the amount of water will remain constant. Overflowing through adjustable fittings, the oil from this chamber enters the filtering cylinders proper, which are wrapped with filtering cloths in the usual manner. After passing through the cylinders, the oil comes to rest in the main storage body of the filter proper, where a cooling coil may be provided if oil passing through the filter is large enough in quantity to demand it; or if the temperatures are such as to make it necessary to reduce the temperature of the oil. The heating chamber and storage room, however, are separated, so that the necessity for this cooling is not so great as in some types of filtering apparatus.

There are some very clever features of construction embodied in these filters. For example, on top there is provided a polished brass pan with inclined base, perforated in the lowest corner, so that it will drain forming a very convenient place for oil cans. The cover over the separating reservoir and filtering cylinder is removable and provided with two neat little handles, and the under side of this cover is arranged to carry spare filtering cloths in little pockets. The heating and separating chamber is removable without the use of any tools, and when this chamber and the other cover are removed, the inside of the filter is very accessible. Arrangements for cleaning and taking care of the filter have been worked out with a great deal of pains. The oil which has been filtered and which lies in the storage base of the filter is picked up by the opposite end of the pump previously mentioned and pumped up into a glass tank supported on a pipe stand. This pipe support is provided with an inner pipe, serving as an overflow carrying the oil down and out of the side opening in the base of the stand; the excess oil returning right back to the pump. The oil in the storage space is therefore not pumped up into this glass stand except as used, allowing the oil to come to rest and regain its normal condition.

The glass tank on the overflow stand is serving two purposes; first an indicator of the general operation of the system, and, second, offering a very easy means of determining the efficiency of the action of the filter. This is a point worthy of especial mention, as the stand is up in plain view of the engineer and a glance will tell as to how the whole scheme is working, and the character of the oil coming through the filter.

From the base of this overflow stand, a single pipe with its branches supply the several sight feeds about the engine; and a valve is provided in this line—not far from the overflow stand, which may be closed when the engine is shut down—retaining a tank full of oil to be used when starting up the next time. The opening and closing of this valve is all that is necessary in starting and stopping the entire system. The slight pulsations in the pipe line, due to the operation of the pump, have proven to be very beneficial in keeping the feeds regular. It is a well-known fact that gravity feed cut down to a few drops per minute is liable to close off and cease to flow at all; whereas, if it is running a stream, there is usually little trouble in this direction. It is the intention, in the operation of systems of this nature, to run a stream on all the bearings to be lubricated; and it is self-evident that friction, consequent loss of power, the wear on bearings which is coincident with friction, and the generation of heat, will be reduced to a minimum by supplying clean, cool oil to all the bearings, by the use of such a system, and it is therefore not only from the standpoint of the saving in necessary attendance to keep the oil cups filled, that these filters are valuable, but also from the standpoint of economy in power and repairs.

A number of these systems are successfully running, and we believe that for a great many plants where there are no sub-basements and plants where the engineer is running practically single-handed, this instalation will be found of great value; and it seems that the large power plant design would be more consistently carried out with the instalation of such a system, rendering the units independent of one another.

The appearance is very attractive, the filter usually being painted to match the engine, and the sight feeds and "cinch" fittings used in piping up the systems being very neat and clean.

These oiling systems are manufactured and installed by the Richardson-Phenix Co., Milwaukee, Wis.

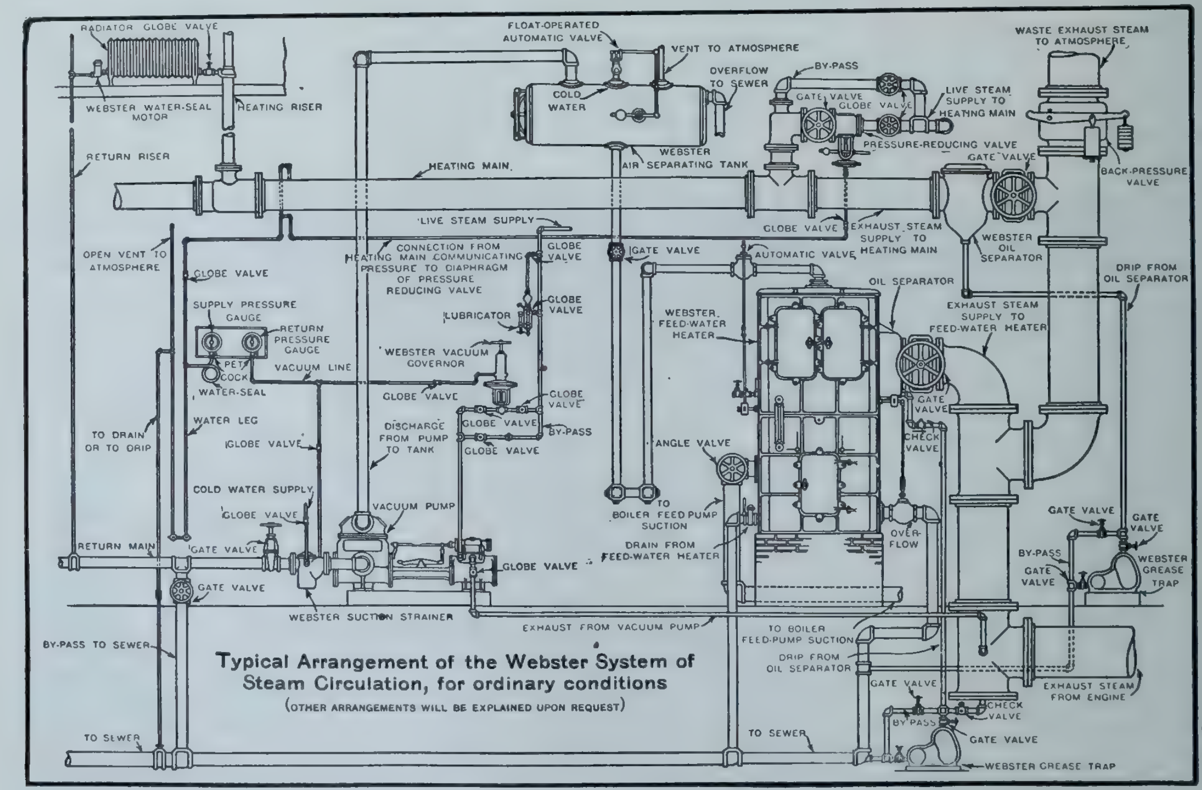
The hydraulic turbines at the Feather River station of the Great Western Power Co. of America are considered to be the most powerful in existence. When running under a 525-foot head at 400 revolutions per minute, they are rated at 18,000 horse power each. Under the reduced head of 420 feet, each turbine develops 14,000 horse power.

Webster System of Steam Heating---Design, Operation *

The Use of Exhaust Steam for Heating—History of the Development of the Webster System and Its Applications, Operation of the System, Etc.

By R. Dawson.

Mr. Chairman and Gentleman of the Canadian Association of Stationary Engineers, as a representative of Darling Brothers, Limited, we wish to thank you for allowing us this opportunity of bringing to the notice of your worthy association some of the points of merits of the Webster System. The reason we say this, is that we believe it is well nigh impossible to go very deeply into the question of exhaust steam heating without bringing to your notice some of the surpassing merits of the Webster System, so if we appear to dwell more on this system than on other types, it is not because we wish to talk of nothing else, but because to do justice to our subject it is impossible to keep the Webster System in the background. We will commence, however, by speaking of steam heating in general, and if, after when we get further advanced into this subject, you find you are hearing too much of the Webster System you can tell us so:



Typical Arrangement of the Webster System of Steam Circulation, for ordinary conditions
(OTHER ARRANGEMENTS WILL BE EXPLAINED UPON REQUEST)

Steam, after being employed in an engine for developing power, retains the greater portion of its heat. If not condensed or otherwise utilized, it can be employed for heating without materially affecting the power of the engine. There are systems of steam heating in which the water of condensation flows directly into the boiler, by gravity. In other systems in use, high pressure steam is carried in the boilers, high or low pressure steam in the heating main and radiators, and the return water of condensation is received by a trap, or a pump and receiver, from which it is forced back into the boiler, or in some instances is wasted.

In using exhaust steam for heating, quite frequently there is insufficient steam derived from the engine exhaust to completely warm an extensive heating system. In these cases it may be necessary to supplement the exhaust steam available by live steam taken directly from the boilers, which may be reduced in pressure to that of the exhaust steam by passing it through a valve partly open, or a pressure reducing valve.

Up till recent years, but little attempt was made to utilize the heat escaping in the exhaust steam from a non-condensing engine, and consequently there was, a good opportunity for the construction of a system which would save annually many times its first cost.

The exhaust steam discharged from a non-condensing engine contains from 20 per cent. to 30 per cent. of water, and considerable oil and greasy matter, which have been employed in lubricating the cylinder. When the engine is freely exhausting into the air, the pressure in the exhaust pipe is, or should be, a little in excess to that of the atmosphere. The effect of passing exhaust steam through heating pipe tends to increase the resistance and cause a back-pressure, which will reduce the effective work of the engine. The engine delivers steam intermittently, but at regular intervals at the end of each stroke. This amount of steam is likely to vary with the work done by the engine, since the engine governor is always adjusted to admit steam in such amount as is required to preserve uniform speed. If the work is light, very little steam will be admitted to the engine. For this reason, the supply available for heating varies by wide limits.

The general requirements for a successful system of exhaust steam heating are: First, the arrangement of a system of piping having such proportions as will make little or no increase in back-pressure on the engine, and will provide for using an intermittent supply of steam. Second, provision for removing the oil from the exhaust, since this

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* Read before Toronto No. 1, C.A.S.E.

will interfere materially with the capacity of the radiating surface, and is also dangerous to the boilers. Third. provision against accident by use of a safety or back-pressure valve at some point in the exhaust pipe, so arranged as to prevent damage to the engine by a sudden increase in the back pressure.

Any system of piping may be adopted in connection with steam heating, but extreme care should be taken in connection with exhaust steam heating systems, so that as little resistance as possible is made to the free flow and circulation of the steam. The radiating surface employed should be such as to give the freest posible circulation. In general, the system which will be preferable, is that in which the main steam pipe is carried directly to the top of the building, and the distributing pipes run from that point, and the radiating surface is supplied by a system of down-flowing risers, which are properly dripped at the bottom, so as to remove all water of condensation that may be caused in the circulation.

The size of exhaust pipe required for an engine of of given power in order that the back pressure shall not exceed a certain amount may easily be computed. The only data required will be the amount of steam that is discharged from the engine. This amount will depend on the workmanship and class to which the engine belongs, but we can assume with little error, that non-condensing engine will require about 40 lbs. of steam per horse power per hour. It is quite true that there are engines of the Corliss or other approved type, which may not require more than 25 to 30 lbs. of steam to the horse power hour; but in order that the pipes may be sufficiently large, it is better to proportion the system from the most uneconomical standpoint, so that there will be no possibility of these exhaust pipes being too small, for any type of engine. We might now give you carefully computed table of the sizes of pipes that are necessary to conduct a certain amount of steam, a certain length at a certain velocity, but as this information is given accurately in most text books upon the subject, we see no reason why we need go into this matter in detail at this point.

Under ordinary conditions, the pressure in the exhaust pipe of an engine, is slightly above the atmospheric pressure, when it is exhausting directly into the air. But systems have been used with considerable success in which the pressure in the exhaust pipe and heating system was less than atmospheric pressure.

Such a system can be constructed by connecting the returns from the heating system to an air-pump, which will remove the water of condensation, and to a great extent the atmospheric pressure. The heating surface in this case will act as a condenser on the steam from the engine. In the case of it being insufficient for the purpose of condensing the steam, a jet or surface condenser supplied with cold water may be used to supplement it. This is practically using a heating system as a gigantic condenser, and this might be termed the first vacuum system that was evolved. In fact the original idea of using a heating system as a condenser was the beginning of a series of experiments, which we might say have led to the now-widely used system of exhaust steam heating known to the vacuum system. But on account of various difficulties that were met with in these experiments it was soon found that it was necessary to devise other arangements so as to procure the various conditions that are required in order to make the system operative under the varying circumstances. In any system of exhaust heating, a by-pass connection to the outside air must be provided, so that if the heating surface in warm weather does not condense all the steam that is furnished by the engine, it may have free access to the atmosphere, so as not to cause undue back pressure in the piping. Of course, in cases where a condenser is used, the condenser could be made use of to handle what steam there was in excess of that required for heating.

Other Systems.

Besides the general system which we have described, other systems of great merit have been devised and put on the market, with many special and patented features. Of these, we may mention first the Williames system, which we may say was the first practical application of a vacuum system of heating. In this system the exhaust from the engine is received into a large upright stand pipe, with back pressure valve at the top. The steam for heating is drawn from near the top and after passing through the radiating surface, is received into a large branch tee, which is supplied with injection water and serves as a condenser. The suction pipe of an air pump is connected to the branch tee, and acts to remove the atmospheric pressure from the entire system. A bypass for summer use is provided. In the original design of this system, provision was made for heating water in a closed hot-water tank, by a portion of the return piping, which water could be used for any purpose needed, as for instance, feeding the boilers or providing hot water for any other purpose. In this system, as we have stated, a back-pressure valve in employed at the top of the main exhaust pipe. This valve is constructed like a check valve opening outward, but is provided with removable or adjustable weights, for the purpose of balancing it at any desired pressure. It is adjusted to open and discharge the steam when the pressure exceeds any desired amount, and to close when the pressure falls. It is almost universally employed to discharge the excess of steam in connection with any system of exhaust heating as already stated. When the steam supplied is not greater than can be condensed and removed in the form of water by the vacuum pump or exhausting device, a vacuum will be produced throughout the entire system and will even extend to the engine. The temperature in the radiators will be less than the boiling point of water and dependent upon the amount of vacuum. When the steam supplied is in excess of that which is condensed, the back pressure valve will open intermittently for a short period of time. The pressure in the main exhaust will be about that of the atmosphere, and the temperature will be 212 degrees Fahrenheit. The exhausting revice will, however, for this condition draw the steam and water of condensation, and the entrained air through the radiators and coils, and may produce a considerable vacuum throughout the entire heating system, which may begin at a point near the exhaust pipe, or position of restricted supply.

Webster System.

The Williames system was patented by M. P. Williames, April 4, 1882, and some of the claims of the patent were sustained by decision in the United States Circuit Court in 1890, in the case of Williames vs. Barnhard, and by the Circuit Court of Appeal in 1899, in the case of McNeelly vs. Williames; this is interesting as being the fundamental patent granted in the United States for circulating steam positively without material condensation through a heating system by means of a suction device or exhauster connected to the return pipe. The Webster system was the immediate successor commercially to the Williames system, and is now extensively used. The Webster system is a higher development of the Williames system, and was promoted originally and is still by Warren Webster. The first patent in connection with the Webster system was obtained January 24, 1893, and since that time, Warren Webster has taken out over ninety patents in the United States covering Webster heating appliances, and their allied specialties. These patents cover as well as heating apparatus, such specialties as feed-water heaters, grease extractors, drying apparatus, filters and purifiers, as well as air washers and humidifiers and various other steam and water appliances that have relation to the problem of heating. In addition to these ninety patents, Warren Webster has been granted eleven trademarks, covering the Webster specialties as well as patents which fully protect his rights in foreign countries, covering practically the same claims as are covered in the United States by the ninety patents above referred to. Warren Webster has recently taken out several patents covering other heating apparatus in connection with the Webster modulation system, and there are now forty-five patents pending in the United States, which have been applied for. We just mention this, as it is interesting as evidence of the extent to which Warren Webster has devoted his attention to perfecting his system, and we believe to-day he has produced the highest development of this department of engineering, and as a result the Webster System is admitted by those experts most qualified to judge to be the latest embodiment of scientific knowledge in the art of heating.

Exhaust Steam.

There is an erroneous notion that live steam is better adapted to heating than exhaust. It has been demonstrated that exhaust steam when rid of its entrained oil and water, by passing it through a separator is in every way suited to the requirements of a steam heating system.

While the heat given off by high pressure steam per square foot of direct radiation is greater than with low, owing to the greater difference in temperature, between the steam inside the radiator and the outside air, an inspection of any table showing the properties of saturated steam, show that pound for pound exhaust steam has a greater heating power when condensed to water at the steam temperature than has live steam at much higher pressures.

A point that has only recently been brought out and is of interest in this connection; is, that low pressure heating appears to be more efficient than high. In a paper read by H. O. Lacount, at a meeting of the American Society of Mechanical Engineers , in May, 1907, results of tests were given, which show that the fuel cost for heating a given space by low pressure steam was less than that where steam at a relatively high pressure was used. The greater economy in heating secured by the use of low-pressure steam as a heating medium is no doubt in a large measure due to the fact, as pointed out several years ago by Prof. J. H. Kinealy, that a radiator at a high temperature keeps the air near the top of the room, at a much higher temperature than when the radiator is filled with steam at a low pressure, and is not so hot. He says, "the higher the temperature of the air at the ceiling of the room, the higher will be the average temperature of the air in contact with the cooling windows and walls of the building, and hence the greater will be the amount of heat transmitted through the cooling walls and windows per hour. That system of heating must undoubtedly be the best and most economical which will maintain the desired temperature of the room nearly uniform from the floor to five feet above it, with a low temperature in the upper part of the room, and this he thinks is done by radiators supplied by steam at a low temperature."

Furthermore, since radiators and coils are commonly placed near the outside walls, it follows that the loss of heat by transmission through these walls, must be greater with high pressure steam than with low.

R. P. Bolton, in a paper read by the American Society of Heating and Ventilating Engineers, mentions the following primary requirements for an effective exhaust steam heating system:

1. Absence of back-pressure on the motive engine, so that they can be designed for the highest economy and work under designed conditions. Effective drainage of condensation from the system of supply pipe, prior to the entry of the steam to the radiating surface.

2. Effective drainage of condensation from the interior heating surfaces, as and when accumulated.

3. Continuous removal of air and its contained moisture from all confined spaces, without retarding the removal of moisture.

4. Removal of water and air from some distance below the line of gavity drainage. These should be accompanied by:

5. A variable capacity of removal adjustable to the extent of use of the heating surfaces, resulting in:

6. Regulation of temperature in separate radiating surfaces.

Mr. Bolton also states as follows:—

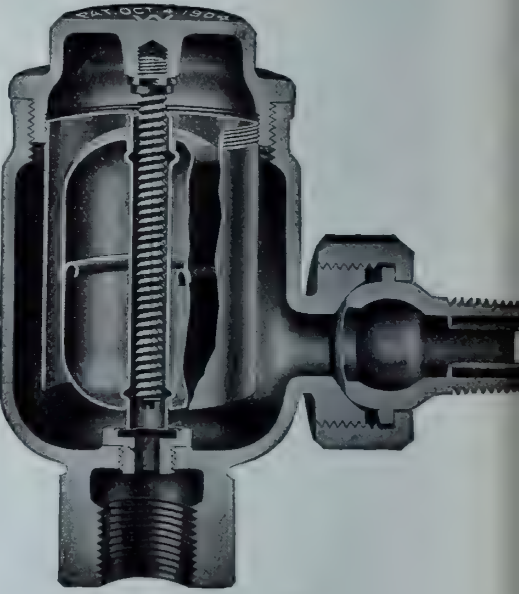
"It will readily be observed that the requirements above recited are not fulfilled by any system employing one pipe for a supply of steam, and for the return of condensation, nor by any system which removes only the air gases, and does not deal with equal certainty with the waters of condensation, nor by any arrangements, establishing a partial suction in the coils or radiators in such a way as to act in opposition to the free drainage of condensation, nor by any apparatus requiring more than one hand valve for the regulation by unskilled persons of a coil or radiator, nor any system incapable of lifting the condensation from a point somewhat lower than the outlet or final disposition."

Engineers agree that the Webster System fulfils all the requirements as called for by Mr. Bolton.

Webster System Explained.

Taking up in the order stated by Mr. Bolton, the primary requirements of an effective exhaust steam heating system, we come first to the question of back-pressure. Accumulation of air and water in pipe and radiators combines to interfere with the free passage of exhaust steam, necessitating the carrying of back pressure unless these are removed by mechanical means. The vacuum pump of the Webster System combined with the other special appliances accomplish the removal of air and water in the pipes and also facilitate the passage of the steam.

Back-pressure systems always require pressure in the radiators above that of the atmosphere, in order to expel the air that is already in the radiators, regardless of the frictional resistance of the piping, or the extent of the system.



Webster Valve for Heating.

A back-pressure valve, provided with removable and adjustable weights for the purpose of creating required resistance to the flow of the steam is placed upon the outlet to the atmosphere, and is capable of being so loaded as to impose upon the engines or pumps a back pressure sufficient to impart the necessary velocity to the steam to cause it to flow to the mains and branches and into the radiators and coils at sufficient pressure to force out the air and gases.

Much has been written in regard to the uneconomical effect of back pressure on engines and pump cylinders. The actual operation can be readily appreciated by any one familiar with the expansion of steam within these cylinders. At whatever points the initial pressure and back pressure stand the disadvantage of the latter is relative not to the former, but to the mean effective or average pressure above the atmosphere on the power side of the piston.

Continued on Page 54.

The Crossley Suction Producer Gas Power Plant

A Producer Gas Plant, Recently Installed at Collingwood, Embodying Some New Features in Producer Design, Necessitated by Canadian Fuel.

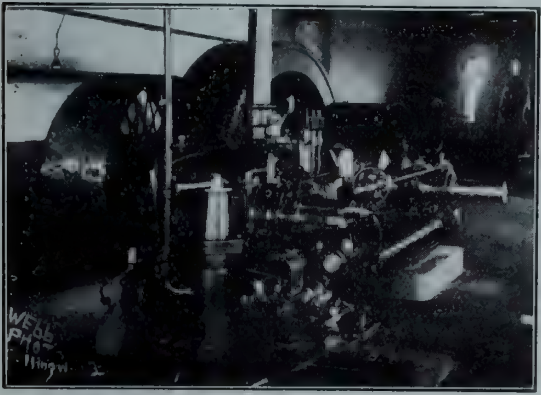


Fig. 1.—Crossley Gas Engine Installed at Collingwood.

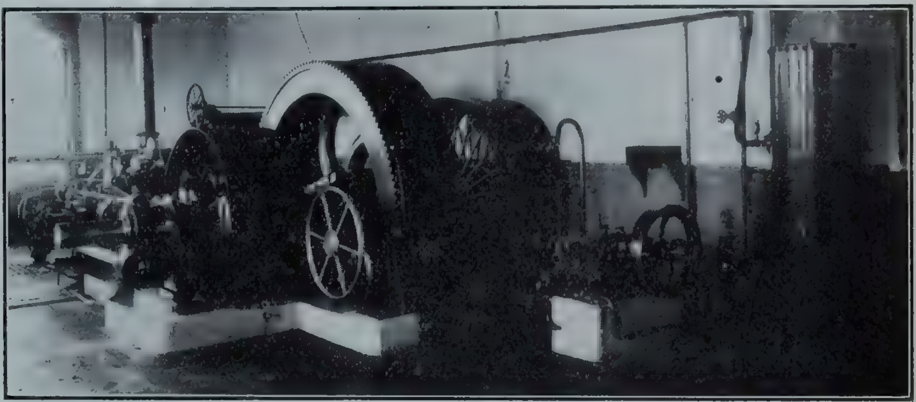


Fig. 2.—Back View of Crossley Gas Engine, Collingwood.

Collingwood has installed an up-to-date gas engine and producer in the new municipal power plant. The engine is a single cylinder, four-cycle Crossley engine, designed for operation on producer gas, and capable of maintaining 104 B.h.p. at 200 r.p.m. Its total weight is about 20 tons with overall dimensions of 15'x8'.

The cylinder bore is 18½" and a stroke of 24". To facilitate repairs, the cylinder is made with a liner which can readily be replaced by another when worn, saving re-boring. As the cylinder bore is the part that fails the soonest in a gas engine, it can be seen that this is a very desirable feature.

Lubrication of the main bearing is effected by the usual type of ring oilers, while the piston and exhaust valve spindle have forced feed, which is necessary in these parts.

In addition to water-cooling the cylinder, the exhaust valve is also so arranged. The piston itself has not been water-cooled, as is frequently done in engines of this size.

The usual heavy gas-engine fly-wheel is in evidence, 8' diameter with a 22" face on one side of which are cast-gear teeth which can be engaged with a standard boring gear when the operator desires to place the engine in its starting position. This is well shown in Fig. 2.

In this position, the engine is started by compressed air, supplied from the little 2 h.p. gasoline air compressor set, shown in front of the fly wheel, Fig. 2. Air storage is provided for by the tank to the right of the set.

To prevent the lack of sensitiveness inherent in some governors through placing too many gears between the shaft and the governor, the latter is driven directly from the main shaft, thereby preventing back-lash of the gears. The governing is of the usual hit-and-miss type.

Producer.

The producer shown in Fig. 3, differs considerably from the usual Crossley type, for similar powers. Realizing that what was satisfactory for the conversion of English fuels into producer gas, might not be equally so with the fuels in use in Canada, because of their different composition, the Crossley Co., had 50 tons of this fuel sent to Manchester, where it was thoroughly tested at their works. This producer, which differs materially in diameter and height from their standard practice (which is shown in Fig. 4) is the outcome of that experimental work.

The grate is of the rotary type, operated through a stuffing-box, permitting of the ash being removed without disturbing the quality of the gas. Coal is introduced into the producer through the Crossley patent rotary type hopper,

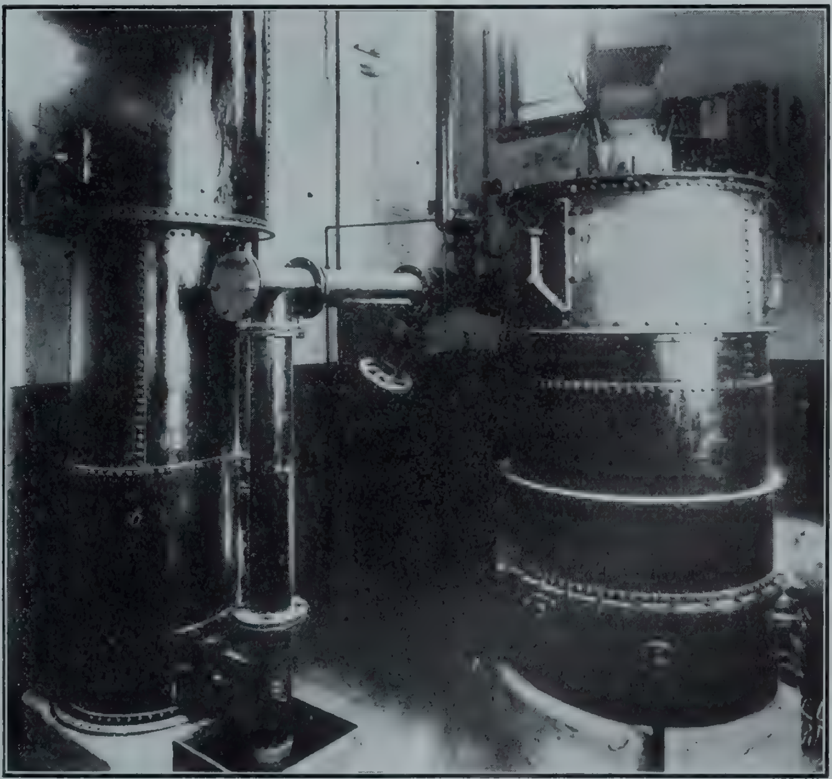
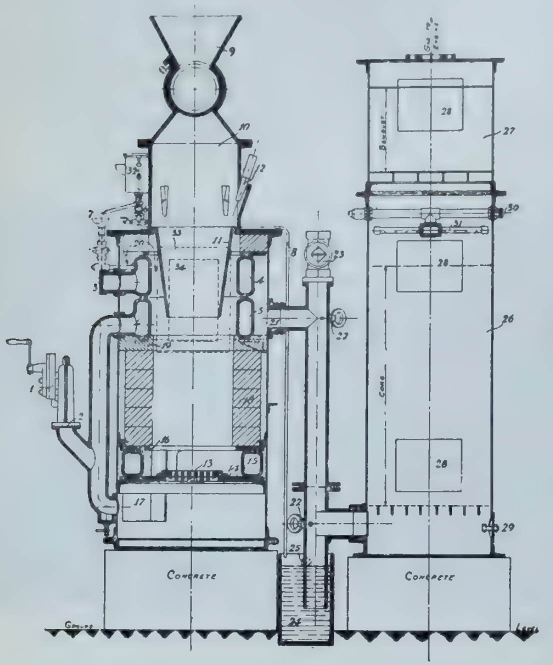


Fig. 3.—Scrubber and Producer, Collingwood, Ont.

which is of a fool-proof construction, and allows no gas to escape. This is shown in Fig. 4, which, as before mentioned, represents their standard practice. Wear in the hopper is taken up by the side-tightening bolts shown, in place of the taper hopper, customarily installed where circular hoppers are used.



No.	DESCRIPTION
1	Hand Fan
2	Damper Valve
3	Air Inlet
4	Vaporiser
5	"
6	Suction Pipe Auto Feed Tank
7	Water Inlet to Vaporiser
8	Overflow from Auto Feed
9	Feeder
10	Hopper
11	" Bell
12	Poker Hole Plugs
13	Firegrate
14	" Support
15	Superheaters
16	Firebrick Support
17	Firedoors
18	Firebrick
19	Fireclay
20	Gas Passage
21	Gas Outlet
22	Cleaning Holes
23	Blow off Cock
24	Seal Pot
25	Overflow from Seal Pot
26	Coke Scrubber
27	Sawdust Scrubber
28	Doors
29	Cleaning Door
30	Water Spray Feed
31	Sprays
32	Automatic Feed to Vaporiser
33	Vaporiser Cleaning Door Frame
34	" " " Cover

Fig. 4.—Sectional View of Producer and Scrubber.

The Crossley patent regulator apportions the amount of water to be supplied the producer, directly as the load. It depends on the float principle for its operation.

To date, the operation of the plant has been very satisfactory, and reflects credit on Chapman & Walker, Toronto, the Crossley agents, Toronto, who supervised the instalation.

WEBSTER SYSTEM OF STEAM HEATING.

Continued From Page 52.

The necessary back pressure must vary considerably with local conditions, increasing as the distance it is required to force the steam increases. It is due not only to the friction of the supply main, but also to the necessity for maintaining in all the radiators a pressure above that of the atmosphere, in order to expel the air. It results in a loss of energy, or an increase of fuel consumption, in the same proportion that such back pressure bears to the total mean effective pressure above the atmosphere, and becomes a greater percentage of loss in the otherwise more economical types of engine, in which the steam is used expansively. The loss due to back pressure increases as the load or total mean effective pressure decreases. When the mean effective pressure is 40 pounds to the square inch, the loss of power or fuel is 2.4 per cent. for a back-pressure of one pound, and where the mean effective pressure is thirty pounds, the loss of power or fuel is 3.2 per cent., so that it can readily be ascertained with a back pressure of 3, 5 or 8 pounds, what a considerable loss will be caused as a result.

The ability to distribute a volume of exhaust steam, not of itself sufficient to exert a serviceable pressure in the main, and to force an effective circulation, is abundantly worthy of the consideration of all heating engineers. Under the usual methods of steam heating, it is necessary to carry a back pressure even during mild weather when the full efficiency of the radiating surface is not demanded, and when there may be but few of the radiators of an extensive heating system in actual operation. In many instances, there is not sufficient exhaust steam to fill the mains, and force a circulation in a gravity system, in which case the shortages must be supplemented by live steam, the evaporation of which necessitates additional expense for fuel. With the Webster System, under similar conditions, the limited volume of exhaust steam may be distributed and utilized in the radiating surface at a pressure less than that of the atmosphere, without calling to its aid any supplemented live steam supply. The engines under these conditions may be operated with the highest obtainable economy when used in connection with heating.

With the Webster System the steam suplied to the heating main may be either at or slightly above or below the pressure of the atmosphere, as required by the best operating conditions due to local circumstances.

Upon opening the supply valve the steam immediately flows into the lower pressure within the radiator, expanding and filling the air space driving the air before it. When the steam reaches the Webster Water Seal Valve, placed at the lowest and farthest point of each radiator, its progress is effectively checked, and as the air and water of condensation accumulate, the Webster Water Seal Valve ejects them into the return system. The steam is thus confined within the radiator until condensed, the condensation creating a partial vacuum which induces a flow of more steam into the radiator.

By the Webster System it is possible to distribute a minimum volume of steam to all points requiring but a moderate heat during mild weather; it is also possible to automatically reduce the amount of steam required to maintain heat at night, since a volume, less than that sufficient to completely fill the radiator at atmospheric pressure, may be distributed wherever needed, with a pressure in the mains below that of the atmosphere, thus reducing the general temperature of the radiators, the rate of condensation during the hours when the building is not occupied, and the cost of fuel during that time.

With this system, it is no longer necessary to "roast" in some portions of a building, in order to secure the proper circulation in the radiation in the more remote parts where a comfortable temperature is desired.

The disposal of exhaust steam under the Webster System, at a pressure as low, or lower, than that required to exhaust freely to the atmosphere, permits of the use of the more economical compound engines and pumps, and consequently enables the designing engineer to employ such engines without the necessity of giving a thought to the evils of "back-pressure" on his large low-pressure cylinders during the steam heating season.

One field in which we have had success is that of changing live steam heating plants so that exhaust steam, otherwise wasted, is utilized for heating. Many manufacturing plants are to-day using live steam for heating where with proper changes the exhaust from the main engine would not only be capable of heating the buildings, but could also heat an abundance of water for manufacturing purposes, as in bleacheries, dye-houses, laundries, and the like.

POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

British Columbia.

REVELSTOKE.—The by-law to raise $27,000 for the extension of water system was carried.

VICTORIA.—The B.C. Marine Railway Co. notified the Ottawa Government that it proposes to put in a suitable shipbuilding plant and will submit a tender for the construction of a Canadian cruiser of the British type at Esquimalt. The cruiser to be constructed on this coast, the first of the vessels for this coast of Canada, will be similar in type to the British scout cruisers laid down in 1908-9 for the home navy, the Bristol, Glasgow, Liverpool, Gloucester, Newcastle and Bellona. The displacement of these vessels is about 3,500 tons. They are engined with turbine machinery, four being equipped with Parsons and one with Curtis turbines. The armament is two six-inch guns and four 4.7 guns. The B.C. Marine Railway Co. is to move its Vancouver shipyards in the near future from their present location to a site selected near the Second Narrows, where a larger slipway will be put in and the plant is to be increased, new machinery and equipment being ordered.

VANCOUVER.—A recent order-in-council passed by the provincial authorities stipulates that the Western Canada Power Co., which is developing water power at Stave Lake, must be able to furnish 20,000 horse power by Sept. 1st, 1911. The company is pushing construction work on its plant, and has just let a contract for clearing the right of way, and erecting poles on eleven miles on the route of the transmission lines. It is placing an order for forty miles of steel cable, the largest contract of its kind that has been placed in this city. At the works electric energy has already displaced a steam plant.

Saskatchewan.

SASKATOON.—The city has decided in favor of making a contract with the Saskatchewan Power Co., which means that the Saskatchewan River at this point will be harnessed to provide cheap electrical energy. The company is to build a generating plant twelve miles below the city at a cost in the neighborhood of one million dollar.

PRINCE ALBERT.—A by-law will be submitted to the ratepayers for a new $12,000 filtration plant.

WEYBURN.—The following equipment will be installed in the power plant. One Cross compound engine; condenser, feed water heater and piping; one 250 K.W. alternating current generator with exciter switchboard, etc. Geo. Ross, secretary-treasurer.

SWIFT CURRENT.—The contract for tile pipe has been awarded to Blackmer and Post Pipe Co., St. Louis, U.S.A., $10,082.78, and for water mains to Munderloh & Co., Ltd., Montreal. 2-inch, $16.42 per 100 feet; 3-inch, $25.87 per 100 feet; 4-inch, $38.82 per 100 feet; 6-inch, $63.70 per 100 feet; 8-inch, $100.55 per 100 feet; 10-inch, $177.16 per 100 feet. Specials, 15 cents per lb.

Manitoba.

WINNIPEG.—Sealed tenders addressed to the Chairman of the Board of Control, Winnipeg, Man., will be received at the office of the undersigned up to August 25th, 1910, for the supply of machinery capable of boring or drilling holes in the limestone rock from the bottom or top of the City Water Works Wells, which are 15 feet in diameter and from 60 to 100 feet deep. Specifications and forms of tender together with conditions governing tenders as prescribed by by-law, may be obtained at the office of the city engineer. M. Peterson, secretary.

WINNIPEG.—Sealed tenders on prescribed forms, addressed to the chairman of the Board of Control, Winnipeg, and marked on the envelope "City of Winnipeg Electrical Distribution System, Tender for Cable," will be received at the office of the undersigned up to noon on Thursday, September 1st, 1910, for the manufacture, delivery and installation, 46,000 feet of thirteen thousand volt, three-core cable. Copies of the specifications and form of tender may be obtained at the Power Engineer's Office, Carnegie Library Building, Winnipeg. These specifications may also be examined at the offices of Messrs. Smith, Kerry & Chace, Confederation Life Building, Toronto. M. Peterson, secretary.

Ontario.

LANARK.—T. B. Cadwell has purchased the waterpower at Playfair and will transmit it to Lanark to run his factories. Its capacity is about 500 horsepower. Mr. Cadwell has also purchased a power from Bruce Lees, giving him full control of all the Playfair powers.

TORONTO.—The Northern Electric & Mfg. Co., have removed their offices from 60 Front St., to 112 Bay St.

HAMILTON.—The Canadian Tungsten Lamp Co., have opened a branch at 518 Somerset Block, Winnipeg. W. E. Skinner will be manager of the Winnipeg office.

SEAFORTH.—The ratepayers of Seaforth voted in favor of three by-laws submitted by the council. The first asked for a guarantee of the bonds of the Bell Engine & Thresher Co., to the sum of $50,000 to permit of the enlargement and extension of the present plant for the purpose of manufacturing gasoline traction engines for the western trade. The second was for the acceptance of Hydro-electric power, and the third provided for the voting of $25,000 for the installation of an electric lighting and power system. All three by-laws were passed by a practically unanimous vote.

Quebec.

MONTMAGNY.—Tenders will be received until August 29th for wharf extension. R. C. Desrochers, secretary, Department of Public Works, Ottawa.

ST. HYACINTHE.—A report from St. Barnabe says that there is excitement throughout the district over the striking of a hundred barrel oil well and at the same time a gas well, by parties who have been boring for the past two years. The men employed by the local company, which has been prosecuting the prospective work with the drills struck the shell of the oil stands, and with a roar and rush both gas and oil came rushing up from a depth of 1,800 feet, soon flowing over the top. The gas pressure was at least two hundred pounds, dark liquid spraying over the ground. As the well had given evidence of a strike earlier in the week tanks had been prepared, and already four hundred barrels have been secured, and it is being tanked at the rate of one hundred barrels per day.

FARNHAM.—The town is interested in the proposed extensive development of electrical power on the Yamaska river. A short time ago the ratepayers authorized the expenditure of $100,000 for local improvements, including an extension of the municipal electric plant. Ross & Holgate, consulting electrical engineers, were retained in the corporation's interests and have prepared a preliminary report covering the possibilities of the Yamaska river for development of electrical power. A head of approximately 27 feet is available and it is estimated that between 800 and 1,000 horse power can be obtained. The Farnham council are preparing a campaign to bring power users to the town and inducements of cheap power will be held out to manufacturers.

New Brunswick.

GRAND FALLS.—The contract for installation of water system, has been awarded to Powers & Brewer, contractors, and embraces furnishing and laying 20,000 feet of cast iron pipe, reservoir, pumping station and pump.

ST. JOHN.—It is announced that progress had been made in the negotiations for the transfer of the interests in the Grand Falls Power Co., at Grand Falls, N.B., to a company in which Sir Wm. Van Horne is interested. Among those present were Barton E. Kingman and Harry McLoughlin, of New York, members of the Grand Falls Power Co., James Robinson, ex-M.P., of Millerton, N.B.; A. J. Gregory, K.C., of Fredericton, and J. A. Brock, of Montreal.

BOOK REVIEWS.

STEAM TURBINES.—By Walter S. Leland, S.B., Assistant Professor of Naval Architecture, Massachusetts Institute of Technology, and American Society of Naval Architects and Marine Engineers; published by the American School of Correspondence, Chicago, Ill., size 6½ x 9½; pages 129; illustrations 99; bound in cloth.

This is a reference work on the development, advantages, and disadvantages of the steam turbine, and the design, selection, operation and maintenance of steam turbine plants and turbo-generators, to form a part of the course in the American School of Correspondence, principally, but also on sale to the general public, and has been written for the practical man, for the man less interested in the finer points of theory than in the results accomplished, and the way they are secured by the most successful builders of the steam turbine. Nevertheless, the fundamental principles have been brought out in sufficient detail for intelligent mechanical design. As an introduction, the fundamental principles of turbine design are dealt with, followed by a description of the various types on the market. installations and their performances under different conditions are discussed, followed by discourses on single-stage impulse turbines, compound impulse turbines, reaction turbines, and a final chapter discussing turbine governing. The book is an excellent one, containing so much practical information, in a very intelligible form.

THE WEATHERING OF COAL.—By S. W. Parr and W. F. Wheeler, is issued by the Engineering Experiment Station of the University of Illinois as Bulletin No. 38. This bulletin embodies the results of weathering tests conducted on car-load lots of coal for a period of one year, in the course of which, coal from various mines was exposed in covered bins, open bins and under water. The results are presented in the form of charts which show graphically the losses in heating value resulting from each condition of exposure. Copies of Bulletin No. 38 may be obtained gratis on application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

JOURNAL OF THE AMERICAN SOCIETY OF NAVAL ENGINEERS.—Vol. 22, No. 2, May 1910; published at Washington, D.C.; size 6 x 9 ins.; illustrated; paper cover.

This quarterly issue is especially good, containing many articles above the ordinary. While several of the articles deal with naval construction and naval protection, such, for example as articles on Gun Erosion, a Study of Erosion, and the Submersible, other articles like the Elektra Steam Turbine, and the Test of Thornycroft Boilers, Fuel Oil, Apparatus and Fireroom Fans on Torpedo Boat Destroyer Roe, as well as numerous articles in the "Notes" department deal with power problems. Among the latter may be mentioned, more particularly, articles on Electricity on Warships, Superheating, Turbines—C. A. Parsons' Late Patents, Impurities causing Scale and Corrosion, Kerosene in Boilers, Boiler Corrosion, Elumination of Oil from Condensed Steam, Future Development of the Steam Turbine, Schulz Steam Turbine, Internal Combustion for Marine Propulsion, Formulae connecting the Pressure and Temperature of Saturated Steam, Magnitude of the Losses Incidental to the Transformation of the Energy in Coal to Electrical Energy, Economy of Steam Heating by Independent Low-pressure Steam Boiler or from the Exhaust of the Steam Turbine, Effect of Superheat, Vacuum, Initial Pressure and Feedwater Temperature on the Water Rate and Coal Consumption of Turbines and Lubrication and Lubricants. Most of these articles contain many useful points for engineers in every station.

CATALOGUES.

AIR COMPRESSORS.—Tilghman's Patent Sand Blast Co., Ltd., Broadheath, near Manchester, Eng., have issued a neat catalogue, consisting of a series of loose-leafs, printed on one side only, bound in a neat covering. Each sheet is descriptive of one of their many kinds of machines. Among the features relative to air compressors that are mentioned are, circulating arrangement, high speed compressors for belt drive, steam drive, or electric drive, steam drive with positively operated valves, horizontal and vertical two stage compressors with inter cooler for belt, steam or electric drive, double-acting single cylinder steam drive, and vacuum pumps, as well as many other types. The descriptions are brief, but to the point. It is a very handy book for any one interested in air power, to have.

AMMONIA FITTINGS.—Is the title of a very neat and well gotten out 60 page book of the Vilter Manufacturing Co., Milwaukee, Wis., and it is their catalogue F-10. Ammonia valves of all kinds, cocks, regulators, elbows, crosses, flanges, couplings, return bends, bushings, traps, fittings, gaskets, etc., are all dealt with at length, the various sizes and types being conveniently listed for ready reference as the manufacturers point out, it contains only the several standard lines of Velter ammonia fittings, and does not include sundries, supplies, or such special fittings as are not subject to general demand. An endeavor was made to have the illustrations and tables convey easily readable information without too much detail. A copy of the book may be had by those interested if application be made to department "M" of the company. Refrigeration men should by all means have a copy.

THE PRODUCTS OF KENNICOTT.—This is the title of a series of bulletins bound in an attractive brown cover, issued by the Kennicott Water Softener Co., Chicago Heights, Ill. As the name implies, the pamphlets are descriptive of the products of the company, including water-softeners, boilers of all kinds, water towers, steel tanks, water weighers, etc. The principal article dealt with is their specialty, the water-softener. This is dealt with at some length and the reasons why such an appliance is essential, and all the necessary theory is given in connection with the description. Numerous installations are shown, from every corner of the globe, showing the universal acceptance of their product. Their use for varied industries is also shown by these same illustrations. It is a remarkably well-gotten up booklet on their varied products.

TANGERTIAL WHEELS.—This is the title of a reference list of users of the tangertial wheels built by the Escher-Wyss & Co., Zurich, Switzerland. Several typical installations are illustrated and some curves from tests made are included.

WATER TURBINES.—A long list of users of Escher-Wyss water turbine is given in catalogue No. 168 W, issued by the Escher-Wyss & Co., Zurich, Switzerland. Photos of installations are also included in the booklet.

REFRIGERATING AND ICE MAKING MACHINERY.—This 32 page, large size booklet, No. 143-E gives a long list of 432 customers, with whom the Escher-Wyss Co., Ltd., Zurich, Switzerland, have placed refrigerating machinery of various kinds. In the strict sense, it is not a catalogue but merely a reference list, for only a very little information is given along with a few illustrations. These latter illustrate a few of their typical installations.

STEAM TURBINES.—Catalogue No. 143-D, of the Escher-Wyss & Co., Zurich, Switzerland, is a complete list of all the users of the Zoelly Steam Turbine, which this firm makes. In all, the installation are 434, very full information respecting each being given.

TURBO-PUMPS.—A complete list of users, as well as a number of illustrations of typical installations, is given in catalogue No. 110-T P, Escher-Wyss & Co., Zurich, Switzerland. In addition several tests are cited, curves from which are shown.

POWER STATION.—The Urft-Valley Embankment and Power Station at Heimbach, Rhine Province, Germany, is fully described and illustrated in publication No. 142-W, of Escher-Wyss & Co., Zurich, Switzerland. The engineering difficulties encountered, and the methods of overcoming them are dealt with. All the power-house equipment is fully described and illustrated both by detail line drawings and photos. A large drawing, appended, gives the ground plan, and shows the method of installing. To the hydro-electric engineer, it is a book of great palue.

POPULAR FITTINGS.—Publication No. 615 of Veritys Ltd., Astor, Birmingham, Eng., is devoted to the numerous lines of popular fittings that they manufacture. The 16 pages are filled with illustrations and price lists making a convenient book for reference.

MAIN SWITCHES, FUSES AND CIRCUIT-BREAKERS.—This is a 16 page price-list of these lines made by Veritys, Ltd., Aston, Birmingham, Eng. It is very conveniently arranged, and lists all their different lines. A large variety are given, making the selection of suitable ones a very simple matter.

BATTERY CHARGING RHEOSTATS.—This is the title of an attractive 48 page booklet just published by the Cutler-Hammer Mfg. Co., Milwaukee, Wis. The booklet describes this company's entire line of battery charging rheostats, for all purposes. Full page illustrations of the various types are shown, besides several special types such as a motor-generator set and a panel for use with a gas engine driven dynamo and storage battery. One section of the booklet is devoted to descriptions and illustrations of protective panels and devices. The applications and advantages of the low current cut-out, maximum voltage cut-out, solenoid switch and overload circuit breaker arrangements are pointed out. The method of tabulating tne electrical data and list of prices is noteworthy, all information being condensed into a single table. This publication which may be had on request, should prove of value to all interested in battery charging.

POWER STATION.—"A record in power station equipment" is the title of a little 12 page booklet from Bellis and Morcom, Ltd., Birmingham, England, for whom, Laurie and Lamb, Montreal, are the Canadian agents. The booklet describes how a gas plant, on failure, was thrown out, at Johannesburg, and replaced by two 500 k.w. sets driven by Bellis Tripple Expansion engines. A fine commendatory article, reprinted from the "Electrical Engineer," is included in the booklet, and describes the conditions of installation and the accruing advantages of using high speed steam engines. An additional article on the financial results, from the "Financial Times," is also very favorable to the company. The plant was so satisfactory that further additions of reciprocating engines and steam turbines have been installed, of the Bellis make.

DART UNIONS AND FLANGES.—A neat little folder issued by the Dart Union Co., 93 Niagara St., Toronto, lists the different kinds of unions and flanges made by them, giving a complete price list. The lists are well illustrated with large cross-sectional views, which bring out the salient feature of the point, viz., the two bronze seat, feature. Nine illustrations are shown. Every engineer interested in piping should have a copy for reference.

TWINVOLUTE TURBINE PUMPS.—As made by the Watson-Stillman Co., New York, are described in catalogue No. 75, which is a 56 page booklet. Following a general description of the twinvolute pump, the booklet goes into detail, giving the advantages of the twinvolute waterway, fully illustrating their contentions. The reason that no unbalanced end thrust exists in twinvolute pumps using the double or opposed suction impeller, is also shown, with a number of examples of typical installations, as well as numerous sectional views of the pumps, which are particularly instructive. Line drawings with the parts clearly identified, accentuates the latter feature. Curves from tests on these wheels are shown and explained. In addition, a lot of hydraulic data is appended making the booklet very useful for reference purposes.

OSRAM LAMPS.—An 8-page vest pocket sized brochure, devoted to the above product, has been issued by Factory Products, Toronto, who are the Canadian agents. The salient features concerning efficiency, longevity, adaptability, brilliancy, heat, and suitability, are given, and the different types illustrated and listed conveniently. Mention is also made to the line of carbon lamps for which they are also the agents.

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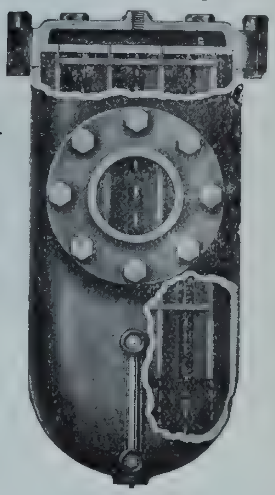

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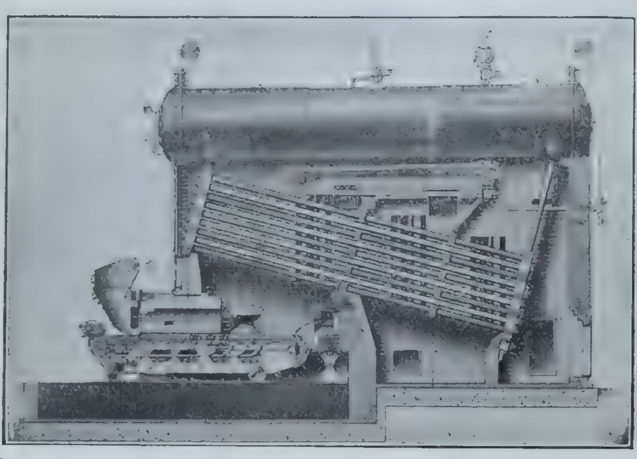

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Boiler Feed Water Regulators.

Canadian Fairbanks Co., Ltd., Montreal

Boiler Mountings.

Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal
Darling Bros., Montreal
The John Inglis Co., Ltd., Toronto
Lunkenheimer Co., Cincinnati, Ohio
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Boiler Settings.

Harbison-Walker Refractories Co., Pittsburg, Pa.

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The Paul B. Huyette Co., Philadelphia
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Boilers.

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Jenckes Machine Co., Sherbrooke, Que.
Jones Underfeed Stoker Co., Montreal.
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.
The Wm. Hamilton Co., Peterborough

Boilers, Horizontal Tubular.

Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough, Ont.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Boilers, Locomotive

Jno. Inglis Co., Ltd., Toronto
Goldie & McCulloch Co., Galt, Ont.
The Wm. Hamilton Co , Peterborough

Boilers, Marine.

Babcock & Wilcox, Montreal
Goldie & McCulloch Co., Galt.
The Wm Hamilton Co., Peterborough.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Boilers, Vertical.

Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Boilers, Water Tube.

Babcock & Wilcox, Montreal
The John Inglis Co., Ltd., Toronto
Polson Iron Works, Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.

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Vilter Mfg. Co., Milwaukee, Wis.

Canners' Machinery.

J. C. Wilson & Co., Glenora, Ont.

Cars, Transfer.

Corbet Foundry and Machine Co., Owen Sound

Castings, Brass.

Hercules Float Works, Springfield, Mass,
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
J. C. Wilson & Co., Glenora, Ont.

Cement Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
Jno. McDougall Caledonian Iron Works, Montreal

Chemicals.

Dearborn Drug and Chemical Works Chicago
Nichols Chemical Mfg. Co., Montreal

Circuit-Breakers.

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Coal and Ash Conveyors.

Babcock & Wilcox, Montreal
Peiler & McKenzie, Montreal, Que.

Coal Handling Machinery

Standard Engineering Co., Toronto

Cold Storage Architects.

E. J. Greenstreet, Toronto

Condensers.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
Goldie & McCulloch Co., Galt.
Jno. Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Peiler & McKenzie, Montreal, Que.
Vilter Mfg. Co., Milwaukee, Wis.

Consulting Engineers.

Bayfield & Archibald, Vancouver, B.C.
de Gaspe Beaubien, Montreal.
Rowland Brittain, Vancouver, B.C.
W. S. Brooke, Toronto
Cleveland & Cameron, Vancouver, B.C.
Dutcher & Foreman, Vancouver, B.C.
John T. Farmer, Montreal
Walter J. Francis, Montreal.
J. F. Frew, Vancouver, B.C.
Galt & Smith, Toronto.
E. J. Greenstreet, Toronto
John S. Isdale, Vancouver, B.C.
F. M. G. Johnson, Montreal
Laurie & Lamb, Montreal
Marchand & Donnelly, Ottawa, Ont.
Ralph D. Mershon, Montreal
C. H. & P. H. Mitchell, Toronto
Moore & Scollan, Toronto
John B. McRae, Ottawa
Morris Engineering Co., Vancouver, B.C.
J. M. Robertson, Montreal.
J. M. Shanly, Montreal.
Standard Engineering Co., Toronto
C. S. Youle, Victoria, B.C.

Contractors, Structural Steel

Canadian Fairbanks Co., Ltd., Montreal
Corbet Foundry and Machine Co. Owen Sound

Conveyor Machinery.

Canadian Fairbanks Co., Ltd , Montreal
Jno. McDougall Caledonian Iron Works, Montreal

Cork Insulation.

Canadian Fairbanks Co., Ltd., Montreal
Linde British Refrigeration Co., Montreal

Couplings.

Canadian Fairbanks Co , Ltd , Montreal
J. C. Wilson & Co., Glenora, Ont.

Cranes, Electric.

Babcock & Wilcox, Montreal
Jno. McDougall Caledonian Iron Works Montreal

Crank Pins.

Michigan Lubricator Co., Detroit

Cross Head Pins.

Michigan Lubricator Co., Detroit

Crushing Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
The Wm. Hamilton Co., Peterborough

Damper Regulators.

Darling Bros., Montreal
Julian d'Este Co., Boston, Mass.
Peiler & MacKenzie, Montreal

Dredges.

Allis-Chalmers-Bullock, Ltd., Montreal

Drills, Rock.

Allis-Chalmers-Bullock, Ltd., Montreal

Drying Machinery.

Canadian Fairbanks Co., Ltd., Montreal
Jno. Inglis Co., Ltd., Toronto

Dynamos.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd , Montreal
Canadian Westinghouse Co., Hamilton
Mechanical & Elec. Lab., Buffalo
Electrical Maintenance & Repair Co., Toronto.

Economizers.

Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal

Electric Power Instalations.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton

Electric Fans.

Matthews & Yates, Manchester .

Electrical Accessories.

Canadian Fairbanks Co , Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Toronto

Electrical Machinery.

Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker Toronto

Electrical Repairs.

Electrical Maintenance & Repair Co., Toronto.
Northern Electric Supply Co., Orillia, Ont.

Elevating Machinery.

Canadian Fairbanks Co., Ltd., Montreal
Goldie & McCulloch Co., Galt.
The John Inglis Co., Ltd., Toronto
Waterous Engine Works Co., Brantford.

Engines, Automatic.

The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works Montreal
Robb Engineering Co., Amherst, N.S.

Engines, Corliss.

Allis-Chalmers-Bullock, Ltd., Montreal
Goldie & McCulloch, Co , Galt.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.
Vilter Mfg. Co., Milwaukee, Wis.

Engines, Gas and Gasoline.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Drummond, McCall & Co., Montreal
Fielding & Platt, Ltd., Gloucester, Eng.
Jno. McDougall Caledonian Iron Works, Montreal

Engines, High Speed, Steam.

Goldie & McCulloch Co., Galt.
The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Engines, Marine

Canadian Fairbanks Co., Ltd., Montreal
Jno. Inglis Co., Ltd., Toronto

Engines, Medium and Low Speed.

Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough.
The John Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Rocking Valve.

The John Inglis Co., Ltd., Toronto

Engines, Saw Mill.

Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough.
The John Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Bran ford

Engines, Single, Compound and Triple Expansion.

Drummond, McCall & Co., Montreal
The Wm. Hamilton Co., Peterborough.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal
Jno. McDougall Caledonian Iron Works, Montreal
Kerr Engine Co., Walkerville
Robb Engineering Co., Amherst. N.S.
Waterous Engine Works Co., Brantford

Engines, Slide Valve

Jno. Inglis Co., Ltd., Toronto
The Wm. Hamilton Co., Peterborough

Engines, Vertical.

The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.

Exhaust Fans.

Matthews & Yates, Manchester

Exhaust Heads.

Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
Standard Engineering Co., Toronto.
Watson & McDaniel Co., Philadelphia

Feed Water Alarms.

Peiler & McKenzie, Montreal, Que.
Reliance Gauge Column Co., Cleveland, Ohio

Feed Water Analyser.

Dearborn Drug and Chemical Works, Chicago

Feed Water Heaters

Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal
Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
Goulds Pump Co., Montreal.
The Wm. Hamilton Co., Peterborough.
The John Inglis Co., Ltd., Toronto
C. Jacobs & Co., Boston, Mass.
National Pipe Bending Co., New Haven, Conn.
Peiler & MacKenzie, Montreal
Robb Engineering Co., Amherst, N.S.
Standard Engineering Co., Toronto
The Stewart Heater Co., Buffalo, N.Y.

Feed Water Regulators

Liberty Mfg. Co., Pittsburg, Pa.
Peiler & McKenzie

Filters, Pressure

Jno. McDougall Caledonian Iron Works Montreal

Fire Brick.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Flanges

Dart Union Co., Toronto

Flumes, Steel.

Corbet Foundry and Machine Co., Owen Sound
The Wm. Hamilton Co., Peterborough
The John Inglis Co., Ltd., Toronto

Furnace Linings.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Fuses.

Geo. C. Royce, West Toronto

Gas Producer Linings.

Harbison. Walker Refractories Co., Pittsburg, Pa.

Gas Producer Plants.

Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Drummond, McCall & Co., Montreal
Fielding & Platt, Ltd., Gloucester, Eng.

Gauge Cocks.

Canadian Fairbanks Co., Ltd., Montreal
The Paul B. Huyette Co , Philadelphia
Peiler & McKenzie, Montreal, Que.
Reliance Gauge Column Co., Cleveland, Ohio

Gauges, Pressure, Vacuum and Recording.

Babcock & Wilcox, Montreal
Lunkenheimer Co., Cincinnati, Ohio
Peiler & MacKenzie, Montreal

Gears, Angle.

The Wm. Hamilton Co., Peterborough
Jno. McDougall Caledonian Iron Works, Montreal
J. C. Wilson & Co., Glenora, Ont.

Gears, Cut.

J. C. Wilson & Co., Glenora, Ont.
The Wm. Hamilton Co., Peterborough

Gears, Mortise.

J. C. Wilson & Co., Glenora, Ont.
The Wm. Hamilton Co., Peterborough

Gears, Reducing

Jno. McDougall Caledonian Iron Works, Montreal

Gears, Worm.

J. C. Wilson & Co., Glenora, Ont.
The Wm. Hamilton Co., Peterborough

Generators.

Allis-Chalmers-Bullock, Montreal
Canadian Electrical & Motor Co., Toronto
Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto

Governors.

Allis-Chalmers-Bullock, Ltd., Montreal

Governors, Water Wheel.

J. C. Wilson & Co., Glenora, Ont.

Graphite.

Jos. Dixon Crucible Co., Jersey City

Grates.

Babcock & Wilcox, Montreal
Butterworth Foundry Co., Ottawa
Canadian Steam Beiler Equipment Co., Toronto
Peiler & McKenzie, Montreal, Que
Diamond Grate Bar Co., Berlin, Ont.
The John Inglis Co., Ltd., Toronto

Gravity Closing Ventilators.

Standard Engineering Co., Toronto.

Grease Cups.

Detroit Lubricator Co., Detroit.
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit

Grease and Oil Extractors.

C. Jacobs & Co., Boston, Mass.

Greases

Canadian Fairbanks Co., Ltd., Montreal
Canadian Oil Companies, Toronto
Jos. Dixon Crucible Co., Jersey City
Electric Boiler Compound Co., Guelph.

Hangers.

Canadian Fairbanks Co., Ltd., Montreal
Goldie & McCulloch Co., Galt.
Jno. McDougall Caledonian Iron Works, Montreal
Waterous Engine Works Co., Brantford
J. C. Wilson & Co., Glenora, Ont.
The Wm. Hamilton Co., Peterborough

Heating Apparatus.

Matthews & Yates, Manchester

Heaters.

Darling Bros., Montreal
Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough
The John Inglis Co., Ltd., Toronto
Peiler & McKenzie, Montreal, Que.
The Stewart Heater Co., Buffalo, N.Y.

Hydraulic Accumulators.

The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

Hydraulic Machinery.

The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

Ice Making Machinery.

Linde British Refrigeration Co., Montreal
Vilter Mfg. Co., Milwaukee, Wis.

Indicators, Electric—All Types.

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Indicators, Steam Engine.

Canadian Fairbanks Co., Ltd., Montreal
Peiler & MacKenzie, Montreal

Indicators, Water.

Detroit Lubricator Co.. Detroit

Injectors.

Detroit Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati, Ohio
Jas. Morrison Brass Mfg. Co., Toronto
Penberthy Injector Co., Windsor.

Iron Filler.

Imperial Waste & Metal Co., Montreal

Lamps, Arc.

Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton

Lamps, Incandescent

Canadian Westinghouse Co., Hamilton
Chapman & Walker, Toronto

Lubricants.

Jos. Dixon Crucible Co., Jersey City

Lubricators, Force Feed.

Darling Bros., Montreal
Detroit Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati
Michigan Lubricator Co., Detroit
Richardson-Phenix Co., Milwaukee, Wis

Lubricators, Plain.

Detroit Lubricator Co., Detroit

Maple Cogs.

The Wm Hamilton Co., Peterborough
J. C. Wilson & Co., Glenora, Ont.

Mechanical Stokers.

Babcock & Wilcox, Montreal
Jones Underfeed Stoker Co., Montreal.
Standard Engineering Co., Toronto

Meters, Electric

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto.

Meters, Water

Drummond, McCall & Co., Montreal
Peiler & MacKenzie, Montreal

Mill Machinery.

Allis-Chalmers-Bullock, Ltd. Montreal
Canadian Fairbanks Co., Ltd., Montreal
Goldie & McCulloch Co., Galt.
The Wm Hamilton Co., Peterborough
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
Madison Williams Mfg, Co., Lindsay, Ont
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford
J. C. Wilson & Co., Glenora, Ont.

Mining Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
The Wm. Hamilton Co., Peterborough
Jno. Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

Motors.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Electrical Maintenance and Repair Co. Toronto.

Motor Controllers.

Canadian Westinghouse Co., Hamilton

Motor Starters.

Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Geo. C. Royce, West Toronto

Oilers, Gang.

Michigan Lubricator Co., Detroit
Sight Feed Oil Pump Co., Milwaukee, Wis

Oilers, Multiple.

Detroit Lubricator Co., Detroit

Oil Filters

Darling Bros., Montreal
Liberty Mfg. Co., Pittsburg, Pa.
Richardson-Phenix Co., Milwaukee, Wis

Oil and Waste Saving Machines.

Canadian Oil and Waste Saving Machin Co., Brockville, Ont.

Oil Separators.

Albany Steam Trap Co., Albany, N.Y.
Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal
Canadian Steam Boiler Equipment Co. Toronto
Darling Bros., Montreal
C. Jacobs & Co., Boston, Mass.
Liberty Mfg. Co., Pittsburg
Peiler & MacKenzie, Montreal
Standard Engineering Co., Toronto

Oils, Lubricating.

Dearborn Drug and Chemical Works, Chicago
Electric Boiler Compound Co., Guelph Ont.

Packing, Leather.

Electric Boiler Compound Co., Guelph Ont.
Garlock Packing Co., Hamilton

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Peiler & McKenzie, Montreal, Que.

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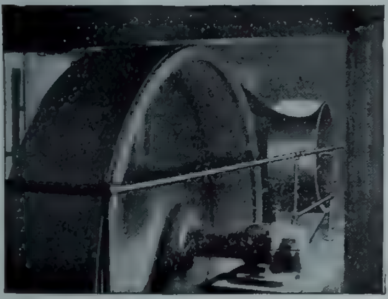

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Drummond, McCall & Co., Montreal
Imperial Waste & Metal Co., Montreal

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Peiler & MacKenzie, Montreal

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The Wm. Hamilton Co., Peterborough

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Canadian Steam Boiler Equipment Co. Toronto
Darling Bros, Montreal
Julian d'Este Co., Boston, Mass.
Liberty Mfg. Co., Pittsburg, Pa.
Peiler & MacKenzie, Montreal
Standard Engineering Co., Toronto.
Watson & McDaniel Co. Philadelphia

Pump Regulators.

Peiler & McKenzie, Montreal

Pump Strainers.

Canadian Steam Boiler Equipment Co., Toronto
Liberty Mfg. Co., Pittsburg, Pa.

Pumps, Air,

Canadian Fairbanks Co., Ltd., Montreal
The John Inglis Co., Ltd., Toronto
Lunkenheimer Co., Cincinnati, Ohio

Pumps, Centifrugal

Jno. Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

Pumps, Geared

Canadian Fairbanks Co., Ltd., Montreal
Jno. Inglis Co., Ltd., Toronto

Pumps, Oil.

Detroit Lubricator Co., Detroit
Michigan Lubricator Co., Detroit
Richardson-Phenix Co., Milwaukee, Wis

Pumps, Steam

Canadian Fairbanks Co., Ltd., Montrea
The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works Montreal

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Drummond, McCall & Co., Montreal

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Linde British Refrigeration Co., Montreal
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Canadian Westinghouse Co., Hamilton

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Goldie & McCulloch Co., Galt.

Safety Valves.

Canadian Fairbanks Co., Ltd, Montreal
Lunkenheimer Co., Cincinnati, Ohio
Peiler & MacKenzie, Montreal

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The Wm. Hamilton Co., Peterborough
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
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Waterous Engine Works Co., Brantford,
J. C. Wilson & Co., Glenora, Ont.

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The John Inglis Co., Ltd., Toronto
Standard Engineering Co., Toronto

Smoke Boxes.

The Wm. Hamilton Co., Peterborough

Smoke Consumers.

Canadian Steam Boiler Equipment Co., Toronto

Smoke Stacks.

Babcock & Wilcox, Montreal
Corbet Foundry and Machine Co., Owen Sound
The Wm. Hamilton Co., Peterborough
The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

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The John Inglis Co., Ltd., Toronto

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J. C. Wilson & Co., Glenora, Ont.

Spur Wheels.

Canadian Fairbanks Co., Ltd, Montreal
J. C. Wilson & Co., Glenora, Ont.
The Wm. Hamilton Co., Peterborough

Stand Pipes, Steel.

The Wm. Hamilton Co., Peterborough
The John Inglis Co., Ltd., Toronto

Steam Packing.

Premier Engineering & Mfg. Co. New York

Steam Pumps.

Darling Bros., Montreal
The John Inglis Co., Ltd., Toronto
Goldie & McCulloch Co., Galt.

Steam Separators.

Albany Steam Trap Co., Albany, N.Y.
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Darling Bros., Montreal
Julian d'Este Co., Boston, Mass.
Ideal Steam Separator & Supply Co., Toronto
Liberty Mfg. Co., Pittsburg, Pa.
Peiler & McKenzie, Montreal
Watson & McDaniel Co., Philadelphia

Steam Specialties.

Darling Bros., Montreal
Julian d'Este Co., Boston, Mass.
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Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
Jas. Morrison Brass Mfg. Co., Toronto.
Peiler & MacKenzie, Montreal
Penberthy Injector Co., Windsor.
Standard Engineering Co., Toronto.
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C. A. Dunham Co., Toronto
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Reliance Gauge Column Co., Cleveland, Ohio
Standard Engineering Co., Toronto
Watson & McDaniel Co., Philadelphia

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Liberty Mfg. Co., Pittsburg, Pa.

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Babcock & Wilcox, Montreal

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Geo. C. Royce, West Toronto

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Darling Bros., Montreal
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Goldie & McCulloch Co., Galt.
The John Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Richardson-Phenix Co., Milwaukee, Wis
Waterous Engine Works Co., Brantford.
The Wm. Hamilton Co., Peterborough

Tanks, Steel.

Corbet Foundry and Machine Co., Owen Sound
The Wm Hamilton Co., Peterborough
Jno. Inglis Co., Ltd., Toronto

Tanks, Water.

The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works Montreal
Pacific Coast Pipe Co., Vancouver, B.C.

Technical Schools.

School of Mining, Kingston
Vancouver School of Engineering, Vancouver, B.C.

Transformers.

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Canadian Fairbanks Co., Ltd. Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Geo. C. Royce, West Toronto

Transmission Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal
The Wm. Hamilton Co., Peterborough
Goldie & McCulloch Co., Galt, Ont.
Jno. McDougall Caledonian Iron Works, Montreal
Waterous Engine Works Co., Brantford

Trucks, Dry Kiln.

Corbet Foundry and Machine Co., Owen Sound, Ont.

Trucks, Factory.

Corbet Foundry and Machine Co., Owen Sound
Jno. Inglis Co., Ltd., Toronto

Tube Cleaners.

Liberty Mfg. Co., Pittsburg, Pa.
Peiler & McKenzie, Montreal, Que.

Tubes, Boiler,

Babcock & Wilcox, Montreal
The John Inglis Co., Ltd., Toronto

Tungsten Lamps.

Canadian Tungsten Lamp Co., Hamilton

Turbine Water Wheels.

Allis-Chalmers-Bullock, Ltd, Montreal
Canadian Boving Co., Toronto
Chas. Barber & Sons, Meaford, Ont.
The Wm. Hamilton Co., Peterborough
Jenckes Machine Co., Sherbrooke, Que.
The Madison Williams Mfg. Co., Lindsay, Ont.
J. C. Wilson & Co., Glenora, Ont.

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Allis-Chalmers-Bullock, Ltd., Montreal
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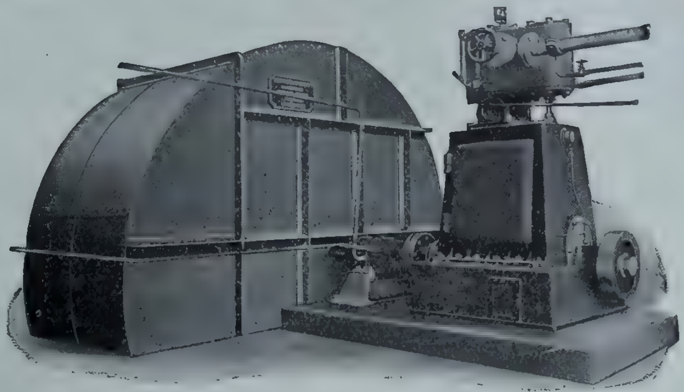

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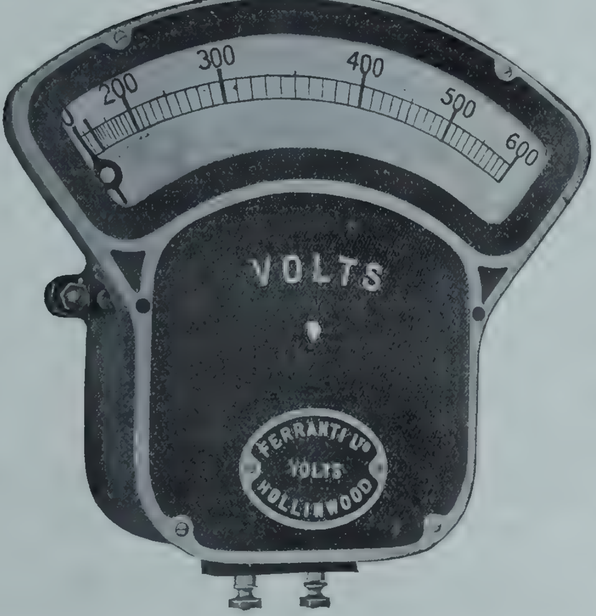

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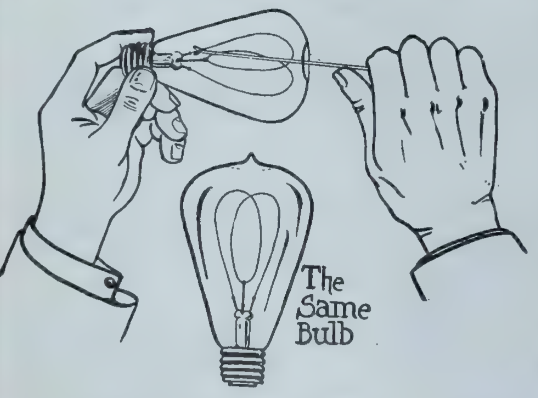

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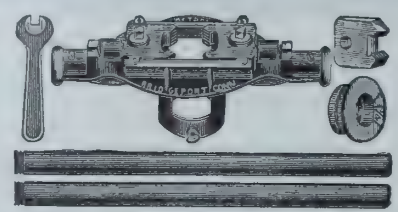

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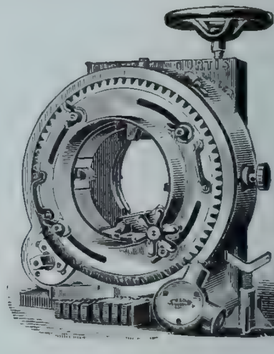

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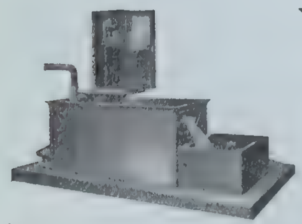
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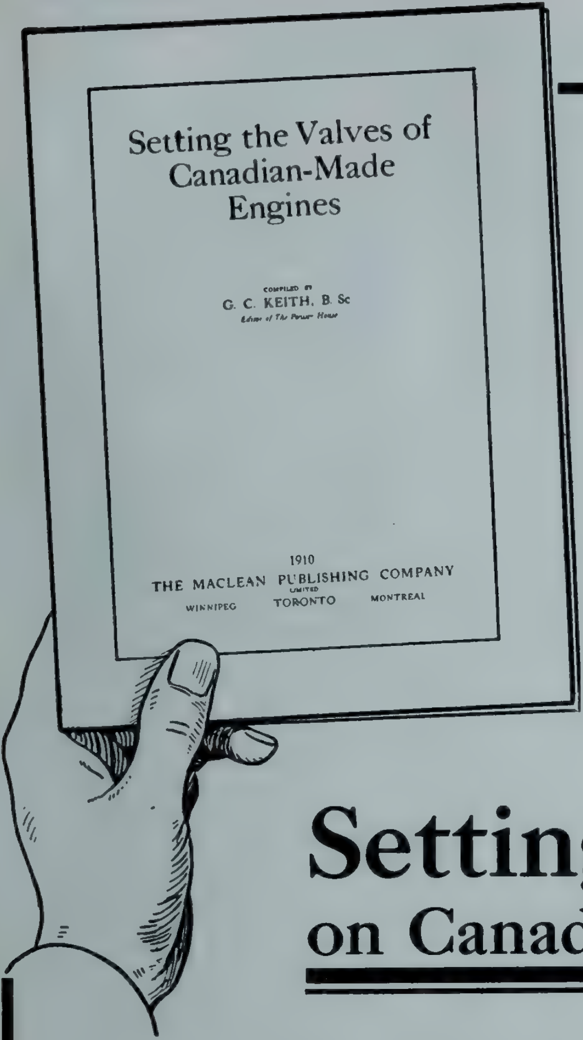

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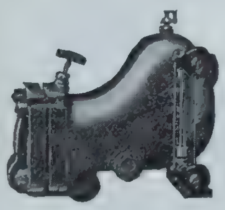

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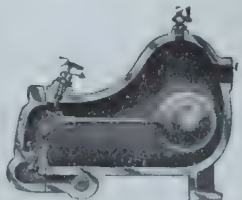

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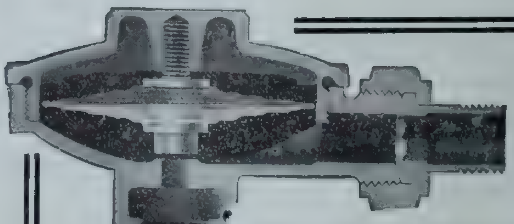

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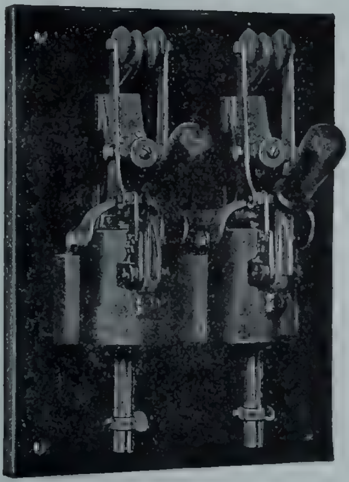

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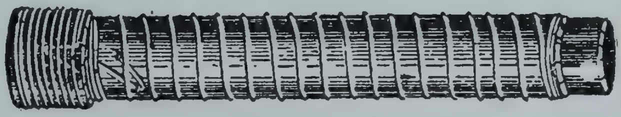

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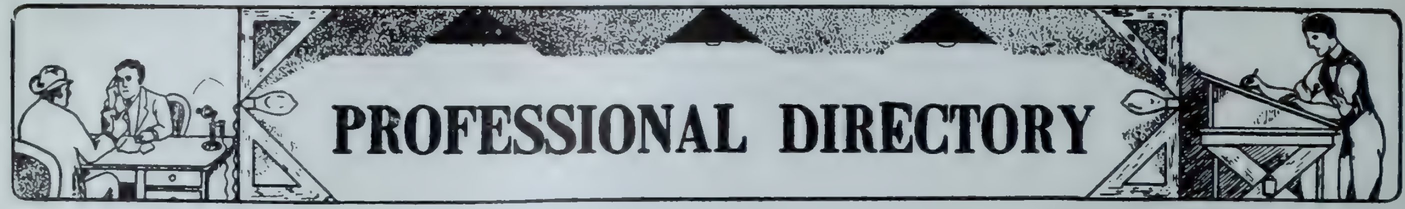

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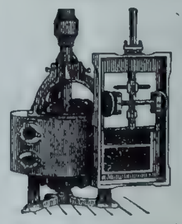

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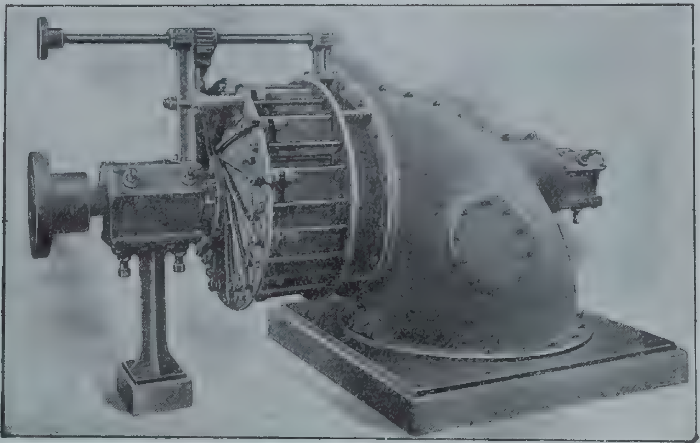

DURABILITY is just as important in a water wheel as in any other machine - and it is a necessary qualification for a first-class wheel.

Durability is the feature of the Samson turbine, because—

The buckets are made of boiler plate, and they cannot become broken by ice, gravel, or similar substances in the water.

Then, when the buckets are cast into the runner, the molten iron flows through holes in the edges of the buckets, pinning them to the cast iron part of the runner, and they never become loose.

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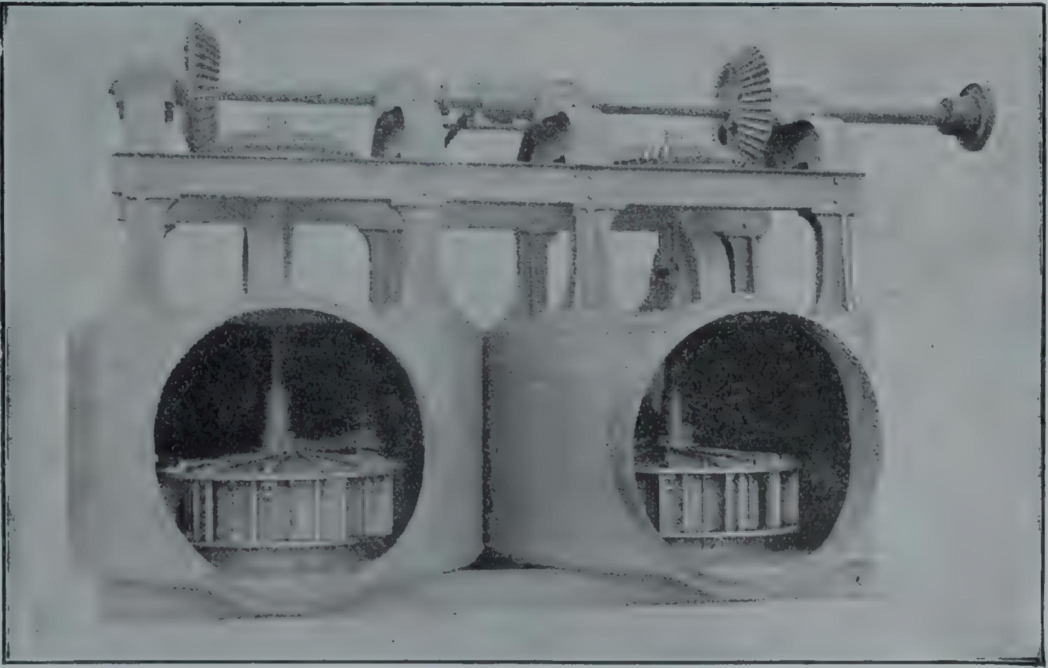
The Cheapest and Most Reliable Power

is water power when harnessed by means of a

"TRIUMPH" TURBINE



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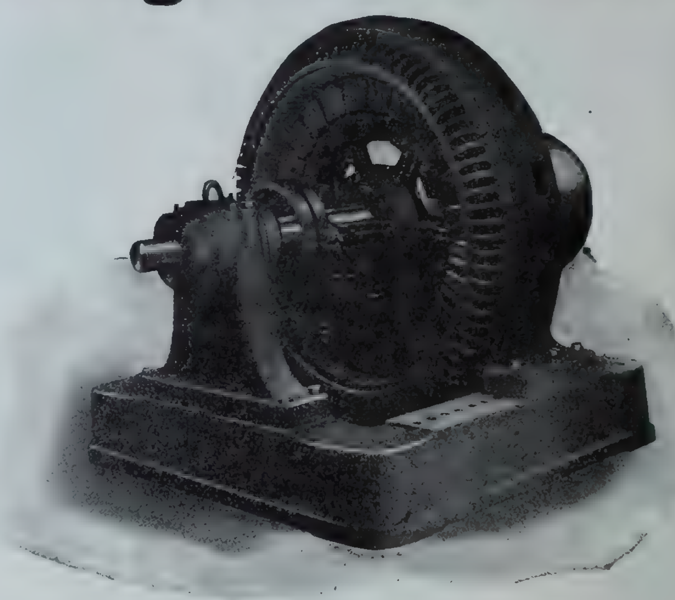

Made in three standard forms, Engine Type, Coupled Type and Belted Type.

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Read all about them in Circular 1113.

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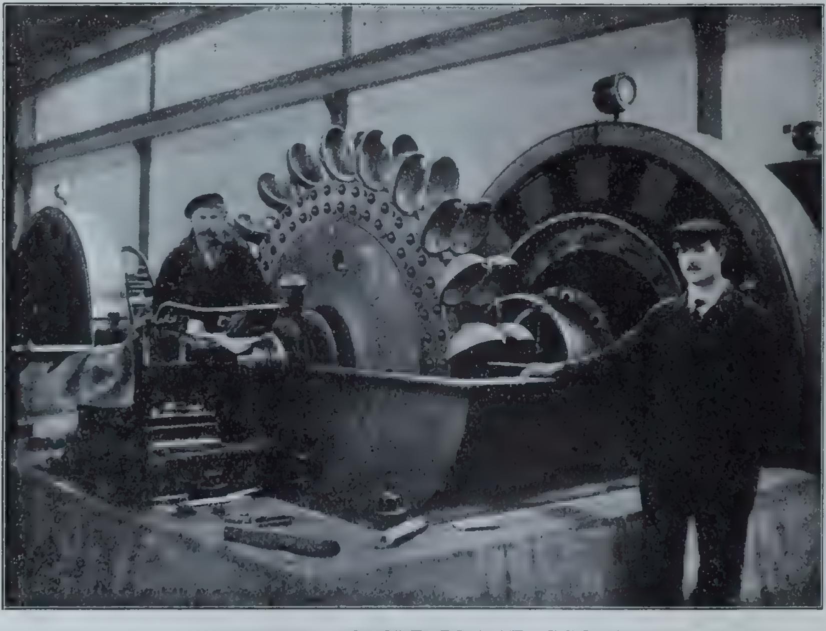

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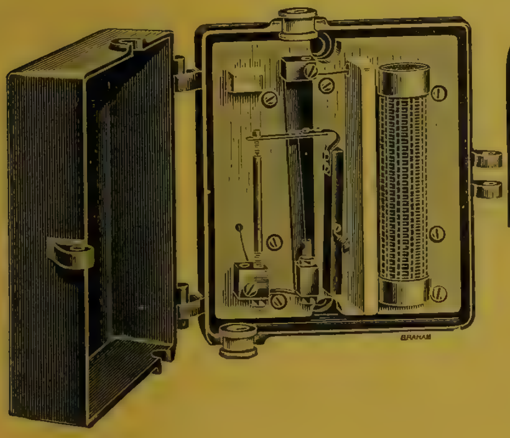

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For Electric Lighting Companies

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The ***N.C.S.*** Thermal Limiter consists of two bars with a wire attached to a spring contact; the bars are of iron, as is also the wire; this arrangement ensuring absolute compensation for anychanges of temperature. It is free from self induction, and equally suitable for Direct Current or Alternating Current circuits.

The whole apparatus is mounted on a china base and enclosed in a cast-iron case, and is so arranged that it can be sealed. It can also be used in conjunction with a fuse box.

THE WAY IT WORKS

is as follows :--When the candle power is exceeded by switching on an additional lamp, the extra current will cause the wire to expand and open the contact at the extremity of the spring. This puts a resistance into the circuit, thus dimming the lamps, and at the same time the wire cools, and closes the contact again; and thus the cycle of operations is repeated. This produces continual flickering of the lights, which will cease as soon as the additional lamp is switched off. A condenser is arranged across the gap to prevent any sparking which might otherwise ensue.

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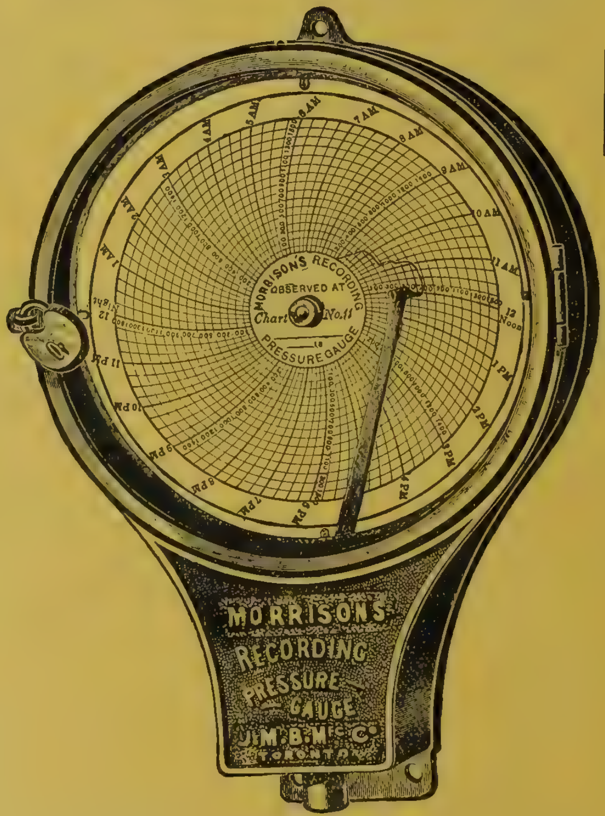

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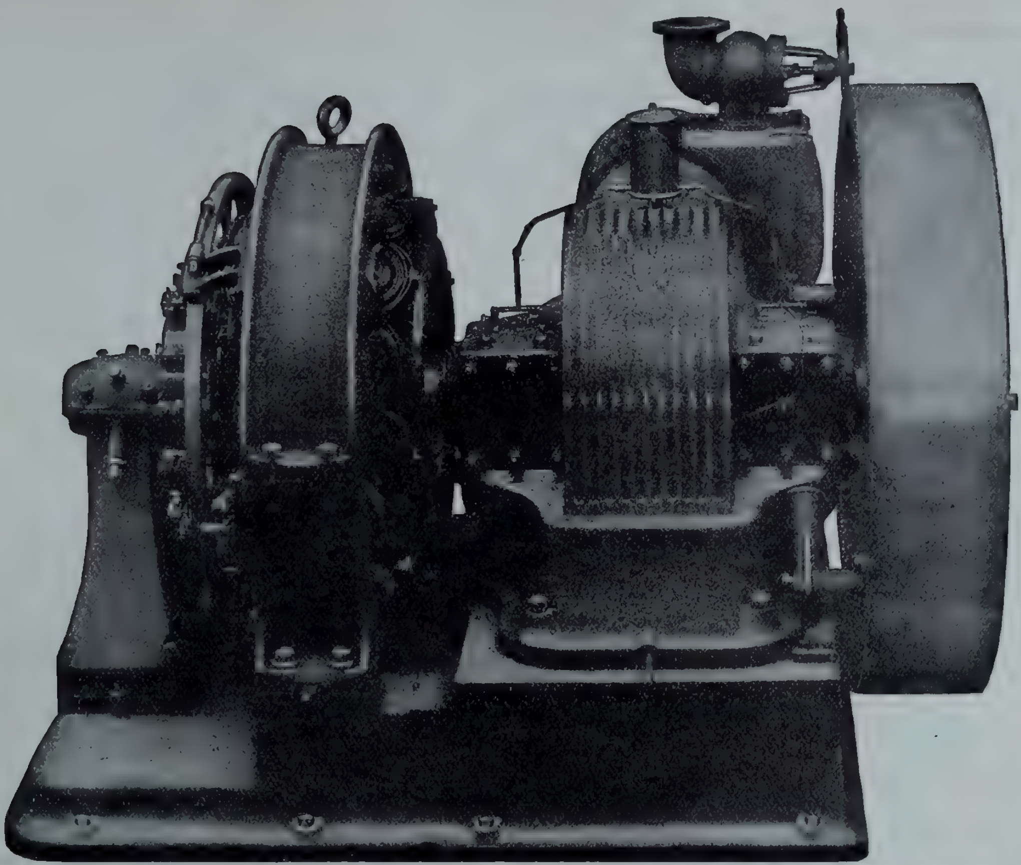

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A Canadian Automatic High-speed Engine that is distinguished for its smooth-running qualities and its sensitiveness of regulation under all loads.

Built in simple and compound units of from 40 to 700 h.p. It is especially adapted for direct dynamo connection for the production of electric light and power.

All parts are few and simple and are built to template so that repairs can be quickly furnished. The bed is heavy and rigid. Cross head guides, main bearings, and face for cylinder attachment are machined in one operation. Piston type valve, double ported, frictionless. Balancing pressure plate slotted to correspond with valve seat. Produces additional passage to cylinder by providing double admission and exhaust edges. Relief valve made absolutely unnecessary. Guaranteed control by Begthrup Inertia Governor.

Tested under full load before leaving the works.

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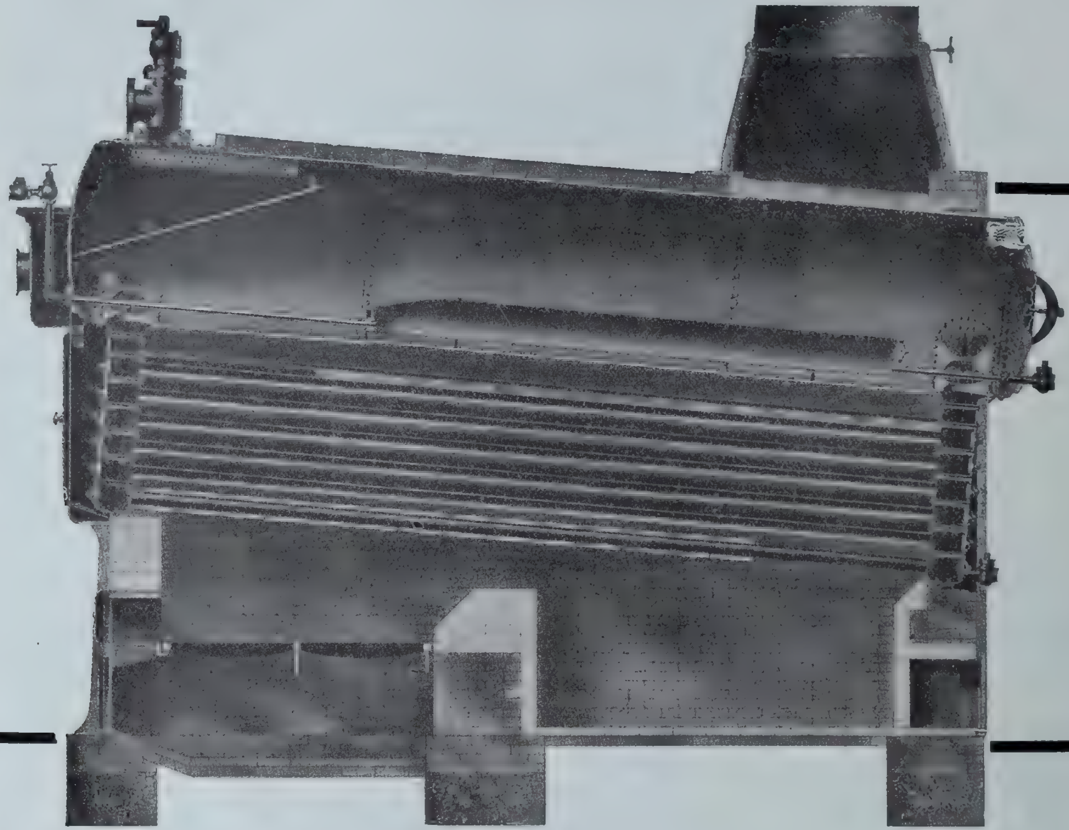
These are some of the features which go to make up the undoubted excellence of the

HEINE SAFETY BOILER



The Heine Boiler makes for economy, because, by separating all water from the steam, it delivers **dry steam** at the boiler valve. Its general efficiency is greatly increased by its wonderful capacity for rapidly absorbing and transmitting heat.

A specialty of the **Heine Boiler** is the **Mud Drum** which effectively precipitates and discharges all scale and mud.

The durability and safety of the **Heine Boiler** are assured, because every conceivable test is applied, not only to the plates, etc., but to the completed boiler also.

We have literature that will interest you. Write for it to-day.

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Vertical Boilers

For convenience, portability and quick steaming qualities this type of boiler is preferred.

Built in all sizes from 4 to 60 h.p. Larger sizes built to order.

This boiler is deservedly popular and enjoys a large and steadily increasing sale.

Bulletin No. 103 to any address on request

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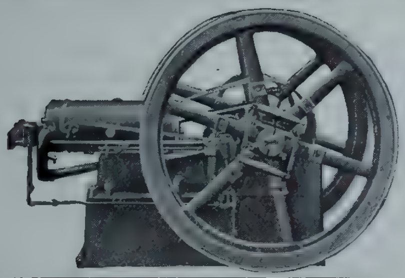

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I H C construction is simple—few parts—each part amply strong.

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The **I H C** line contains an engine for every need—1 to 25 horse-power—vertical or horizontal—stationary, portable (on truck or skids), or tractor. You can easily choose just the engine you want. Investigate these points for yourself. Write us for catalogue and full particulars.

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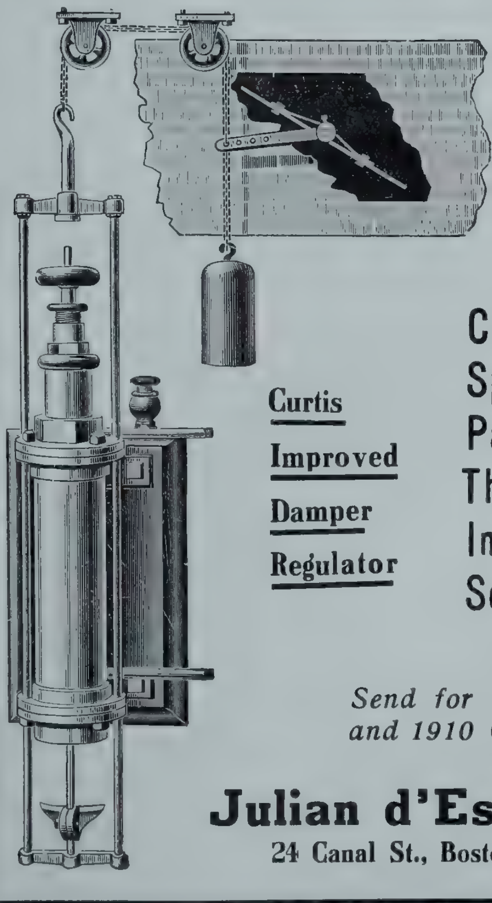

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Curtis Specialties Pay For Themselves In Good Service.

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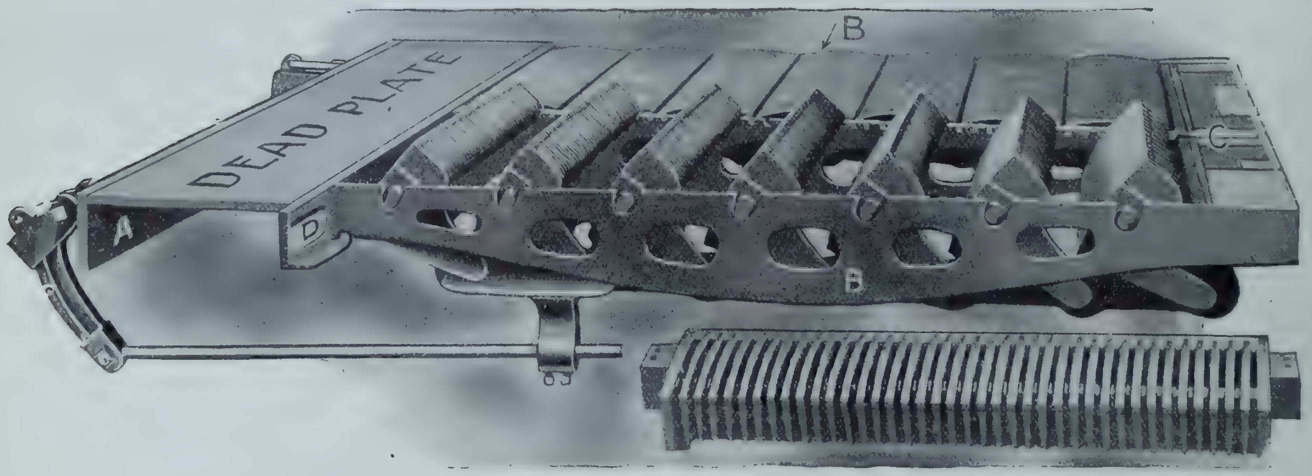
Shaking and Dumping Grate Bar



This Grate will positively solve for you the problem of obtaining perfect combustion of the fuel you use, and will, moreover, give you much better fires and greater economy by enabling you to use the cheapest kinds of fuel (soft and hard coal screenings, hard or run-of-mine coal).

The "CYCLONE" GRATE BAR will generate more steam from the amount of fuel consumed than any other grate in the world, because the construction of the "Cyclone" allows 68 per cent. of air space and 90 per cent. underdraught. Its greatly improved shaking mechanism keeps it absolutely free from clinkers and prevents waste of fuel.

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> T. McAVITY & SONS, LIMITED
>
> Canadian Steam Boiler Equipment Co., St. John, N.B., May 1, 1909.
> Toronto.
>
> Gentlemen,--In reference to your enquiry, beg to state we have had the Cyclone Shaking and Dumping Grate Bars in use in our Water Street Foundry for the past eighteen months. We consider it one of the best Grates of its kind on the market; and if we were installing any more boilers, we would certainly use these Grate Bars, if they cost three times the money they do, as we consider we have saved double the price of the Bars in the last winter.
>
> Yours very truly, T. McAVITY & SONS, Ltd

WRITE US TO-DAY FOR ILLUSTRATED CIRCULAR

Canadian Steam Boiler Equipment Co. Limited

(Sole Manufacturers for Canada)

186 Queen Street East, Toronto

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Scotch Marine Boiler, 14 ft. in diameter, built for the Richelieu and Ontario Co's. Steamer "Rapids Prince."

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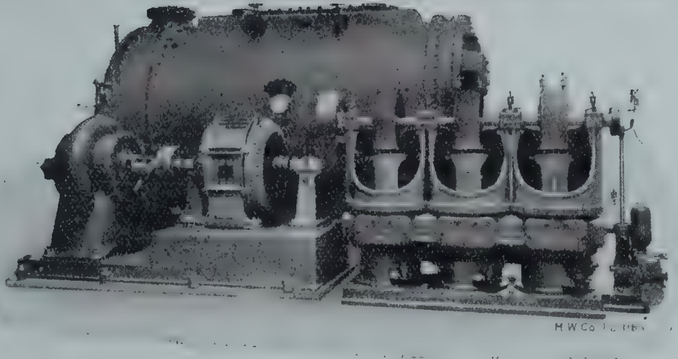

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OF EVERY DESCRIPTION

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All on the Counter-Current Principle

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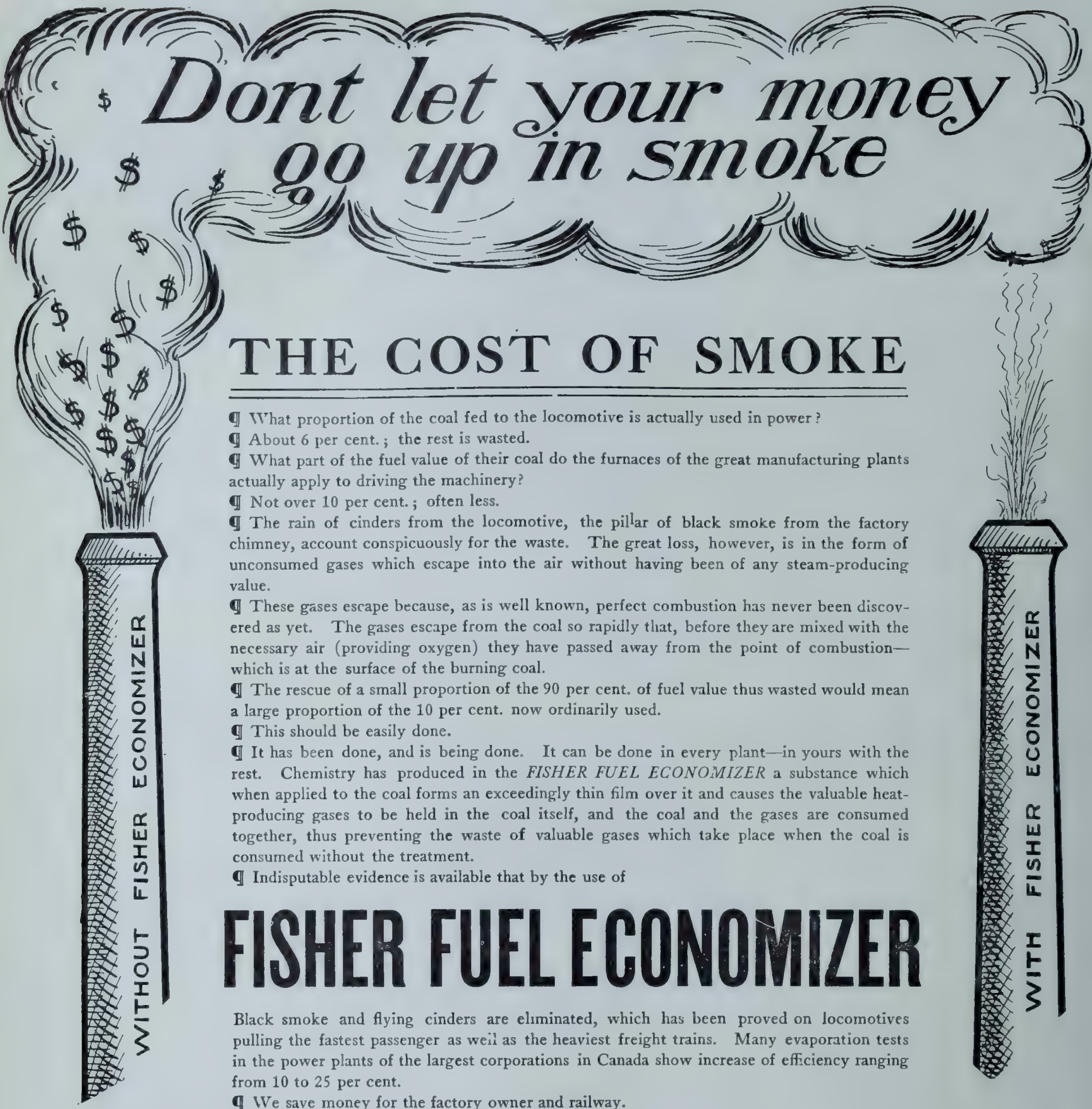


THE COST OF SMOKE

¶ What proportion of the coal fed to the locomotive is actually used in power?

¶ About 6 per cent.; the rest is wasted.

¶ What part of the fuel value of their coal do the furnaces of the great manufacturing plants actually apply to driving the machinery?

¶ Not over 10 per cent.; often less.

¶ The rain of cinders from the locomotive, the pillar of black smoke from the factory chimney, account conspicuously for the waste. The great loss, however, is in the form of unconsumed gases which escape into the air without having been of any steam-producing value.

¶ These gases escape because, as is well known, perfect combustion has never been discovered as yet. The gases escape from the coal so rapidly that, before they are mixed with the necessary air (providing oxygen) they have passed away from the point of combustion—which is at the surface of the burning coal.

¶ The rescue of a small proportion of the 90 per cent. of fuel value thus wasted would mean a large proportion of the 10 per cent. now ordinarily used.

¶ This should be easily done.

¶ It has been done, and is being done. It can be done in every plant—in yours with the rest. Chemistry has produced in the *FISHER FUEL ECONOMIZER* a substance which when applied to the coal forms an exceedingly thin film over it and causes the valuable heat-producing gases to be held in the coal itself, and the coal and the gases are consumed together, thus preventing the waste of valuable gases which take place when the coal is consumed without the treatment.

¶ Indisputable evidence is available that by the use of

FISHER FUEL ECONOMIZER

Black smoke and flying cinders are eliminated, which has been proved on locomotives pulling the fastest passenger as well as the heaviest freight trains. Many evaporation tests in the power plants of the largest corporations in Canada show increase of efficiency ranging from 10 to 25 per cent.

¶ We save money for the factory owner and railway.

¶ We save the fireman much hard and dirty work.

¶ We save the black smoke which pollutes the air.

¶ We reduce your ashes and clinkers half.

¶ We increase and maintain steam to a degree which is impossible without the economizer.

¶ We keep your boiler tubes and grate bars clean, reducing expense of upkeep.

Let Us Prove It to You. Write To-day for Information

Phone Main 2390

Fisher Fuel Economizer Limited

Head Office, 74 Bay St., Toronto, Ont.

MONTREAL	OTTAWA	WINNIPEG
Gerald Rowe, 187 McGill Street	**569 O'Connor Street**	**310 McGreevy Block**
Phone Main 811	*Phone 4494*	*Phone Main 2750*

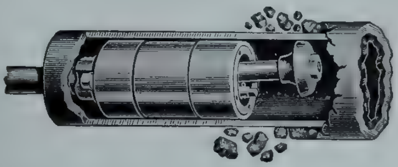
Saved $2 a Week on One Boiler

Doesn't seem much but multiply it by 52 and it's quite a bit. That's what one concern made by using

The Dean Boiler Tube Cleaner

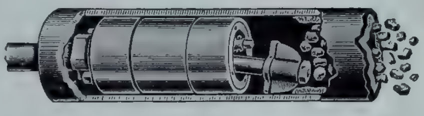
Where there are several boilers and the scale heavy the Dean has saved $150.00 to $1200.00 a year.
That's why we can afford to guarantee to every purchaser that the Dean will pay for itself in six months' use.
Why not try a Dean in one of your boilers and see how much you can save.

Write for booklet No. 130 and our free trial offer



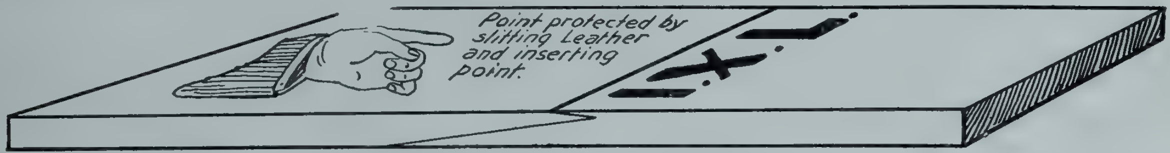
The Dean Boiler Tube Cleaner removing scale from the tube of a return tubular boiler.

THE WM. B. PIERCE CO.
330 Washington Street, Buffalo, N.Y.
Montreal Office : 230 Coristine Bldg., Montreal.



The Dean Boiler Tube Cleaner removing scale from the tube of a water tube boiler.

THE "I.X.L." SPLICE "THE BELTING SPLICE THAT WILL NEVER COME OPEN"



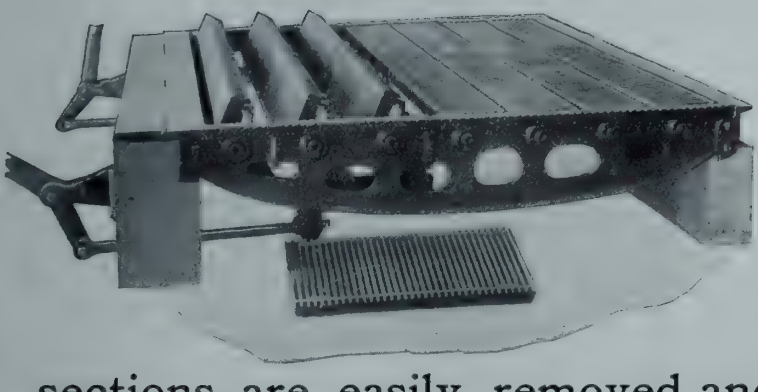
The great trouble with *any* belting—no matter how good the leather—that is joined up with the ordinary splice, is the fact that the splices come open, causing loss and delay. J. D. McArthur's Leather Belting made with the " I.X.L." SPLICE, as shown in this cut, *cannot* come open at the splices. Note the protected point, outside point running same direction as pulley.

J. D. McArthur's Leather Belting is made from Prime British Oak-Tanned Leather, from Close-Trimmed Backs exclusively.

Write for our complete price list. J. D. McARTHUR & CO., Brockville, Ontario

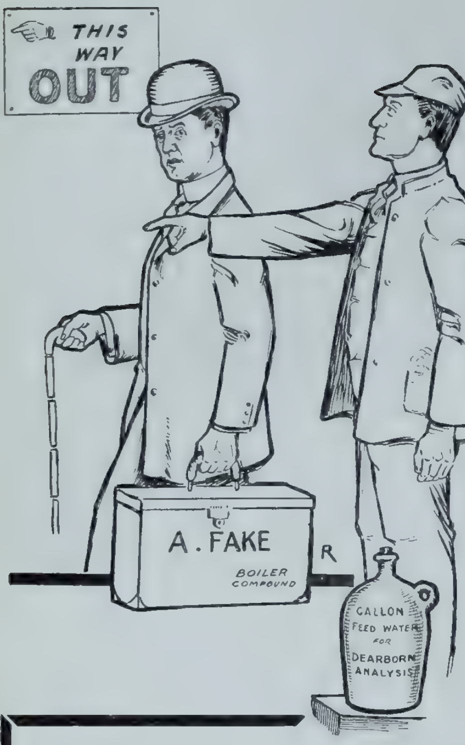
Stock at Toronto Branch 639 King St. East; J. E. Stephenson & Co., Agents

"CAPITAL" SHAKING AND DUMPING GRATE



A comparison of this grate with other shaking grates will show many advantages; the bearings are 3½ inches below the fire, thus ensuring against their burning out rapidly, the sections are easily removed and replaced at low cost, easily operated, greater air space. Send for particulars to

Butterworth Foundry, Limited
OTTAWA


THIS WAY OUT
A. FAKE
BOILER COMPOUND
R
GALLON FEED WATER FOR DEARBORN ANALYSIS

Show Fakirs the Door!

And you may safely put down as a fakir any individual who approaches you with a stock boiler compound proposition. The one sure way of ridding your plant of boiler scale troubles is to subject your boiler feed water to the

Dearborn Individual Treatment

A stock compound has about as much chance of keeping scale and its attendant injuries out of your boiler as a pig has of growing wings. Your first step in the right direction is to draw off a gallon of your feed water and express it to us for free analysis. This analysis will disclose the cause of the trouble, and then, if you desire it, we will make a special preparation to meet your particular needs. Send along that gallon sample to-day.

Dearborn Drug & Chemical Works

ROBERT F. CARR, President

General Offices, Laboratory and Works, Chicago. Eastern Offices, 299 Broadway, New York

Don't Waste Time

or expense cleaning scaly tubes! any money spent in preventing scale is a far more profitable outlay than what it costs to remove the scale after it has formed. Prevent scale by using

INTERNATIONAL

BOILER COMPOUND

But we can't work in the dark; we must find out what your feed water contains before we can mix the compound that will eliminate the scale-forming salts. Express us one gallon of your feed water; we will analyse it *free of charge,* and will forward a TRIAL SAMPLE of our compound guaranteed to banish all your Scale Troubles.

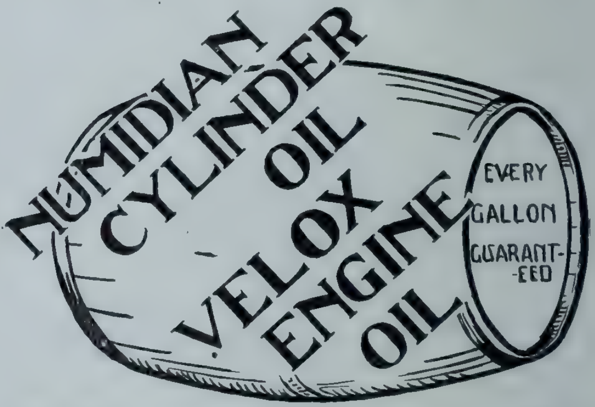
You can make money acting as our agent. Write for details of our offer.

Get in touch with us to-day.

International Boiler Compound Company

144-146 West Michigan St., Chicago, Ill., U.S.A.

The World's Famous Lubricating Oils



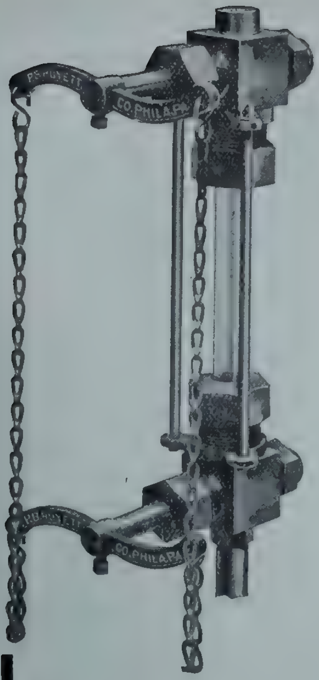
Quality Quantity Price

Freight allowed to destination

Sliptivity Machine Oil
Potato Scale Powder Boiler Cleanser
Oils and Grease of every description

C. C. Snowdon

Wholesale P.O. Box 1384, Calgary


P.B.HUYETT CO. PHILA.PA.
P.B.HUYETT CO. PHILA.PA.

Eliminate Trouble

in your Boiler Room by using the devices illustrated

The "P.B.H." Quick Closing Water Gauge

insures against burns and scalds. A pull of the chain shuts off both steam and water in case of a broken glass. **Sent on Trial.**

The "TORNADO" Steam Boiler Tube Cleaner

Works rapidly, thoroughly and economically. Carries no moisture to wet soot, and blows through the longest tubes.

The "P.B.H." Quick-Opening Self-Closing Gauge Cock (cut at foot)

is simple, efficient, economical and quickly repaired. Guaranteed unleakable for years. Here are a Trio of Appliances every Boiler Room should have!

Write for Catalogue.
SENT ON TRIAL.

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PAUL B.
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Inc.
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Philadelphia,
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WORKS, DAUPHIN AND DELHI STS.

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WHY NOT MAKE MONEY FOR EACH OTHER?

Have you considered that a good Compound will pay for itself by removing the scale in your boilers, and thus enabling them to steam better and quicker? This means a saving in your fuel and repair bills. If you are interested, mail us a sample of scale from your boiler and we will send you a Certificate of Analysis and a full report free of charge. We can refer you to plants in your territory which are using our chemicals continually. When you are in need why not give us a trial?

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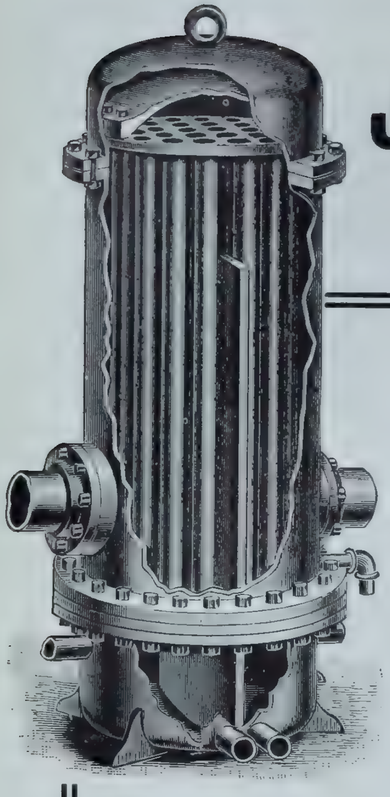
Agencies in all other principal cities.



The
JACOBS
Feed Water
HEATER

is easily the simplest, most effective, and best constructed apparatus of its kind on the market.

It will positively use your exhaust steam to the best advantage, heating your feed water to the boiling point.

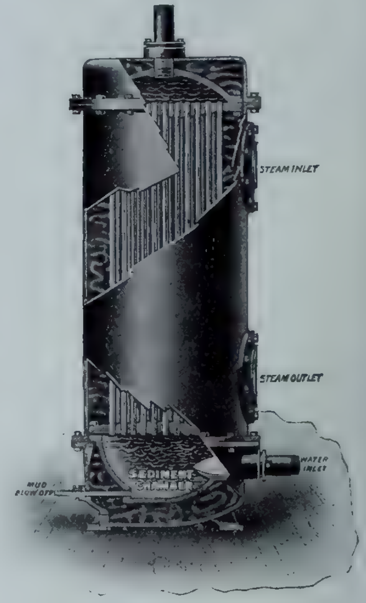
We fully guarantee the JACOBS Heater.

Investigate its merits. Send for descriptive circular.

Chas. J. Jacobs & Co.
42 Oliver Street, BOSTON, Mass.

Mackie Patent Heaters
"Made in Canada."

The tube portion of this heater is not attached to the shell. Allowance for free expansion and contraction makes it the most durable heater on the market.



Goulds Pump Company

National Trust Bldg.,
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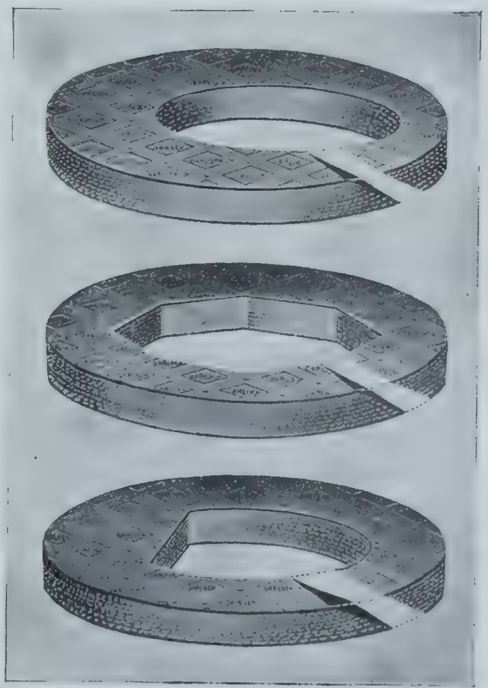
Coristine Building,
MONTREAL



GARLOCK
STEAM HAMMER and ODD SHAPED
Ring Packing

Send us a template of any rings you require in this class. Being an exact fit, they give excellent satisfaction.

THE GARLOCK PACKING CO.
HAMILTON, ONTARIO

Take No Chances

You don't want to take the stuffing boxes apart oftener than necesary, nor do you want any leakage or blowouts. These troubles are annoying at best and may involve costly shut downs, so the price of the packing is the least of the renewal expense. Unless reasonably safe against leakage and blowouts, unless it smoothes rather than scores the rod, unless it may be placed and practically forgotten, a packing might be expensive even if you got it for nothing. You know, too, that penny savings at the expense of dollar losses are not profitable.

Premduro Flexible Metallic Packing

costs only a trifle more than a soft packing, but **it's good for years of service** even on scored rods. Premduro once properly placed needs only a few occasional drops of oil to maintain that easy steam-proof contact which lets an engine do its work best. The small triangular soft metal wires conform perfectly to the rod end box, and the flexibility of the mass prevents binding as the metal expands. There is no undue frictional heat and no danger of the packing fusing or changing its composition. In fact, Premduro although less expensive than other metallic packings offers the highest degree of protection and satisfaction.

Our Guarantee Is Unmistakable. Premduro must make good on every claim or we don't want your money. Tell us where you would like to try Premduro, so that we can send prices and free sample.

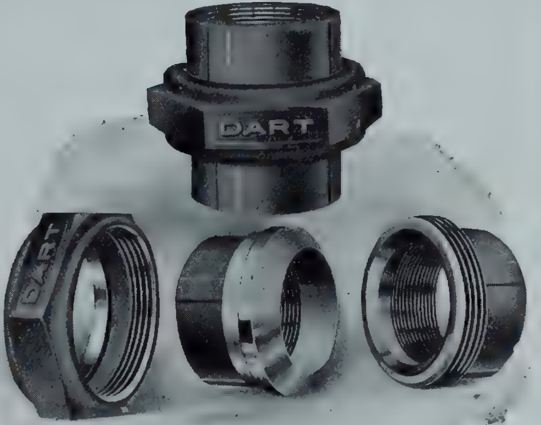
PREMIER ENGINEERING & MANUFACTURING CO.

25 Broad Street, NEW YORK.

The International Supply Co. of Montreal, Eastern Agents

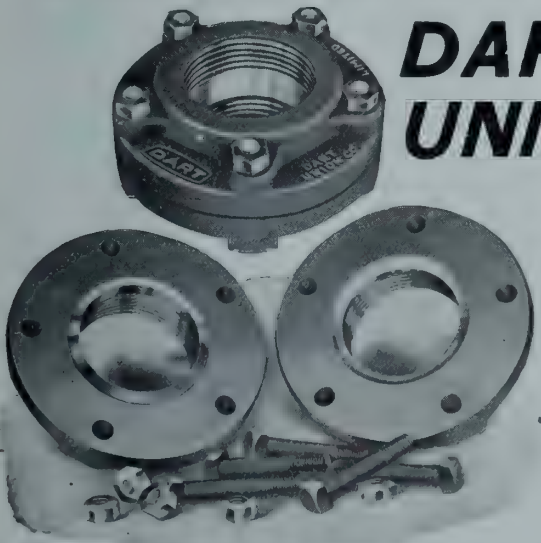
We are open to make Agency arrangements for Ontario and Western Canada. If interested, write to-day. A good proposition for live agents.

Practical Engineers, Note this



A perfect joint that can be made quickly, without packing, whether pipes are in or out of line; that will never leak; and that will stay perfectly steam, air and water-tight until someone deliberately loosens it, is a joint in which you are very much interested. And this is the kind of joint made by

DART UNIONS



All Dart Unions have two smoothly-ground bronze seated sections, forming a ball joint when connected. This joint cannot leak; and the bronze facings make it absolutely impervious to rust or corrosion.

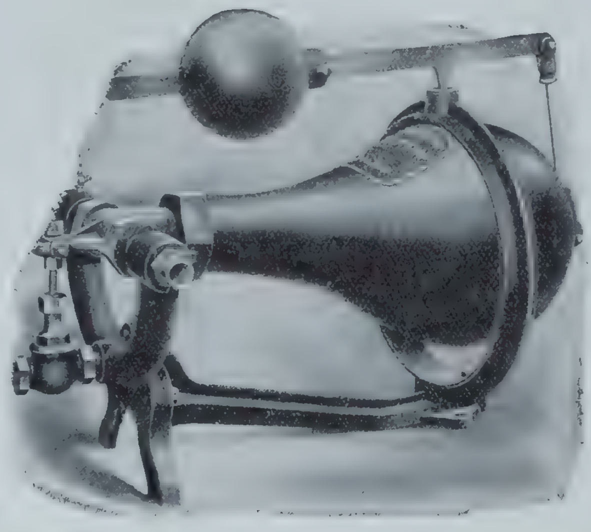
You dealer sells it—or should. Ask him to show you, or write us for illustrated circulars and free sample

Dart Union Co., Limited

Toronto - - - - - Canada

The Saving in Fuel Quickly Repays the Cost of

"BUNDY" STEAM TRAPS



As a rule, the value of fuel saved by its use in one year more than repays the cost of the Bundy Steam Trap.

The best argument in favor of the Bundy—the enormous number now in use are giving absolute satisfaction in every case. Bundy Traps are exceedingly simple and strong in construction. They operate by gravity and stand positively unrivalled in efficiency.

We are prepared to give expert advice for the application of Bundy Traps under any circumstances. Write us to-day for complete catalog and any other information you may require concerning your condensation and boiler feeding problems. We can help you out.

"France" Metallic Packings

are the packings that give the best results under all circumstances. A three-year guarantee accompanies every sale of "France" Metallic Packing; but, as a matter of fact, the life of "France" Packing, under the severest conditions of service, is from 6 to 12 years. It has been demonstrated thousands of times that "France" Packings invariably wear as long as the wearing parts of an engine.

Illustrated catalogue sent free on request

Mason Regulators are the Standard

appliances for regulating steam pressures. The accompanying cut shows the Mason Spring Type Fan Regulator. This is the only perfect device for maintaining uniform boiler pressure either in forced or induced draft systems, operating to control the action of steam-driven fan. It is also used for controlling steam jet blowers. We can supply you with the right reducing valve for every purpose.

Write us for Catalogue

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H. L. PEILER & CO.

52 St. James Street
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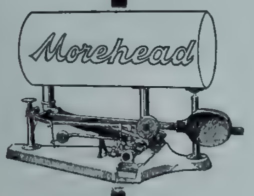
PEILER & LODGE, MONCTON, N.B.

Also Agents for

ASHTON POP VALVES, RELIEF VALVES AND ASHTON GAUGES FOR ALL SERVICES; REILLY MULTICOIL HEATERS AND SURFACE CONDENSERS; BERRY FEED WATER CONTROL; "P.B.H." GAUGE COCKS AND WATER GAUGES; "TORNADO" FUEL CLEANERS.

25 Per Cent. Fuel Saving

Do you, as a steam user, appreciate the full significance of the above phrase? Do you realize that you can put your steam plant into a condition that will effect such a large saving in fuel?



A— Morehead Steam Trap

installation will accomplish results far beyond your highest expectations.

Furthermore, you may have the privilege of proving to your own satisfaction the truth of our claims--at our expense. write for our trial offer proposition, and ask for "Trap Book."

A Guaranteed Investment with Guaranteed Results

Morehead Manufacturing Co.

Dept. J, DETROIT MICH.

Canadian Representatives: A. R. Williams Machinery Co., Toronto; W. H Markle, Montreal; Park Bros., Chatham, Ont.

UNION STEAM PUMP BATTLE CREEK, MICH.
BURNHAM
UNION STEAM PUMP CO. BATTLE CREEK, MICH.

BRASS-FITTED THROUGHOUT

The BURNHAM will not short stroke—and for this reason it is the most suitable pump for HOT WATER SERVICE.

You can always depend on the BURNHAM for handling the condensation from Heating Apparatus, Dryers, etc., etc. Standard sizes in stock.

Darling Bros., Limited

15 OTTAWA ST.

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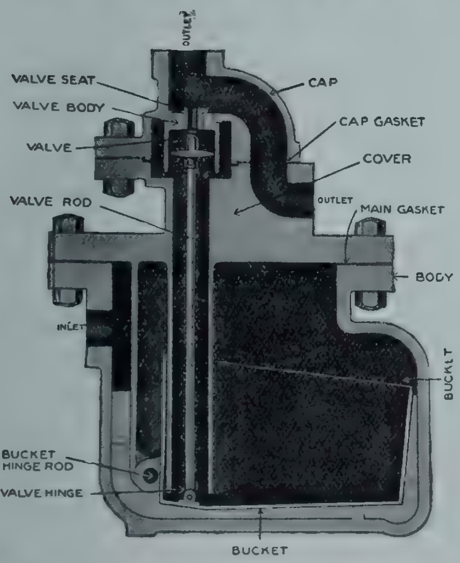
Were you at the Berlin Convention?

If so, you should have a CATALOG of our

STRONG STEAM TRAPS

Registered 4/S Trade Mark

Lest you forget



If you were not, you should by all means send for the catalog---and read about the trap with but two wearing parts (valve and seat) and these are so protected that a long life is assured.

Leaky trap valves = expense. You can test our valves with the trap in operation---a glance tells if the valve needs regrinding, and the valve is removed without disconnecting the piping.

Strong Traps have a pumping action, this not only prevents wire drawing of the valve but increases the efficiency of the system to which they are attached.

The Strong, Carlisle & Hammond Co.

Cleveland, Ohio.

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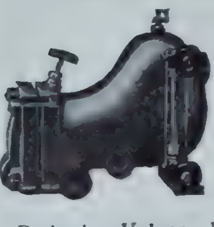
Sole Representatives for Canada

Montreal *Toronto* *St. John, N.B.*
Winnipeg *Calgary* *Vancouver*

The advertiser would like to know where you saw his advertisement—tell him.



McDANIEL IMPROVED STEAM TRAP

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.

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IDEAL STEAM SEPARATOR & SUPPLY CO.
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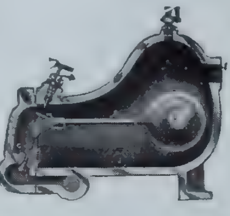
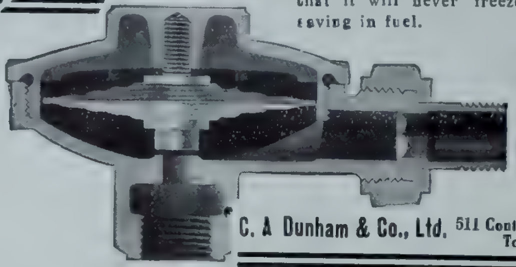




Heating Engineers:—This is what the

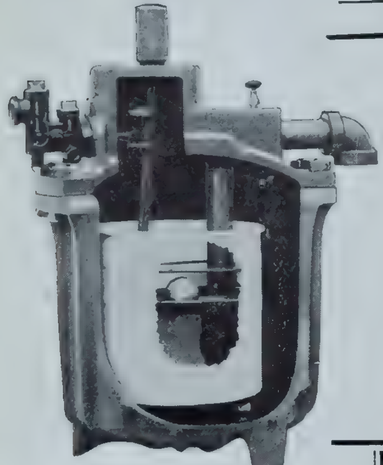
DUNHAM RADIATOR TRAP

Will do for you when applied to the return ends of your radiators: 1. Stop all pounding in pipes and radiators. 2. Do away with all air valves on radiators. 3. Put heat into every inch of every radiator on your system within 30 minutes. 4. Keep the entire system drained so that it will never freeze. 5. Effect a saving in fuel.

Its construction tells you why.

Write us for illustrated circulars.

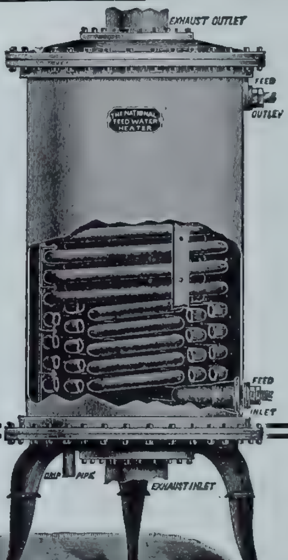
C. A Dunham & Co., Ltd. 511 Continental Life Bldg., Toronto, Ont.



THE ALBANY STEAM TRAP

Will solve the problem for you. Backed by over 40 years' trap experience. Get in touch with the makers:---

The Albany Steam Trap Co.
ALBANY, N.Y.



The National Feed Water Heater

Practical ***Efficient***

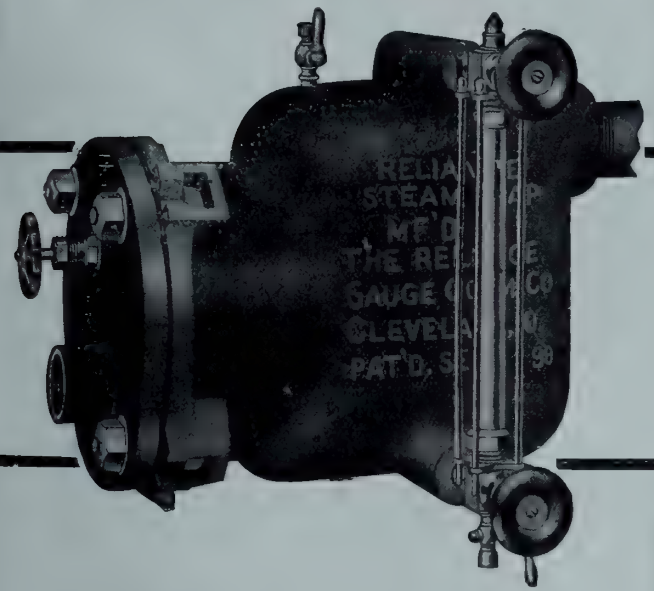
For the past twenty-eight years the National Feed Water Heater has been prime favorite in the leading Power Plants of the Dominion, because it has invariably proved practical and efficient. All joints are brazed and leaking is impossible. There is no pressure at any time on the shell, which never wears out. The tubing (1 to 14 coils) is of seamless brass or copper and is encased in a cast iron or steel shell. To this shell the exhaust steam is admitted, heating the water passing through the tubing.

Send for illustrated catalogue; it contains pointers for YOU

The National Pipe Bending Co.
91 Lloyd Street - - - NEW HAVEN - - - Connecticut

The Trap That Never Fails

The man who wants a trap which is unlimited in capacity, simple and practical in design and guaranteed to give the best results, cannot afford to overlook the



RELIANCE Steam Trap

It will handle every drop of condensation, whether it comes in floods or driblets. The valve is controlled entirely by the inflow of water with an action that is positive and never failing, working equally well on high and low pressure systems.

Every Reliance Trap is fully guaranteed—including the float.

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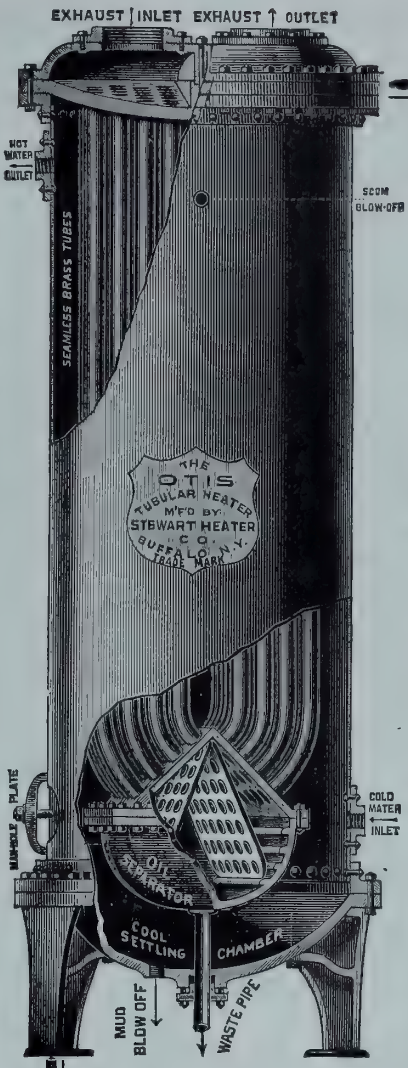
CATALOGUE, FREE

Reliance Gauge Column Co.

5902 Carnegie Avenue
CLEVELAND - - - OHIO



We Pay

all costs of a trial if the

OTIS

Tubular Feed Water Heater Oil Separator and Purifier

does not
MAKE GOOD

Are you making any use of your exhaust steam?

There is power in it which we can harness for you; and use to heat your Feed Water to the boiling point without any back pressure.

The "OTIS" will return the water of condensation from the heating system to the boiler without the additional expense of an eliminator, and will, moreover, extract the oil from the exhaust, so that the steam, after passing through the heater, can be used for other heating purposes.

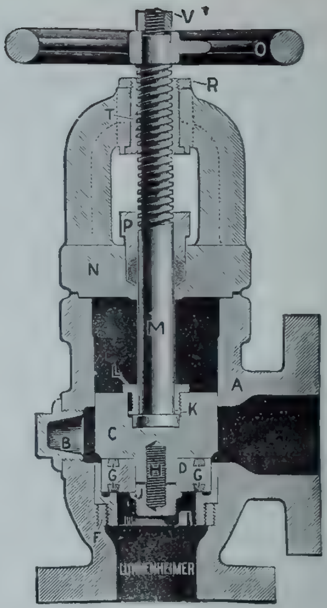
Give the "OTIS" a fair trial and you will be convinced.

Write TO-DAY for catalogue and prices.

The Stewart Heater Co.

189 Norfolk Avenue
BUFFALO : : : N. Y., U. S. A.

LUNKENHEIMER "DURO" BLOW-OFF VALVES



Are guaranteed for 250 pounds working pressure. The cast iron used has a tensile strength of 25,000 pounds per square inch, and the bronze used contains a high percentage of copper and tin. One of the principal advantages in the design of these valves lies in the construction of the seat and disc which provide SELF-CLEANSING SEATING SURFACES, and any scale or dirt that may lodge on the face of the seat will positively be washed off before the disc is firmly seated, thereby insuring a PERFECTLY TIGHT VALVE.

The DISC is DOUBLE SEATED and can be REVERSED or RENEWED when worn. The SEAT is also RENEWABLE, as are also all other parts of the valve subjected to wear.

WRITE FOR CATALOGUE.

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Largest Manufacturers of high-grade Engineering Specialties in the world

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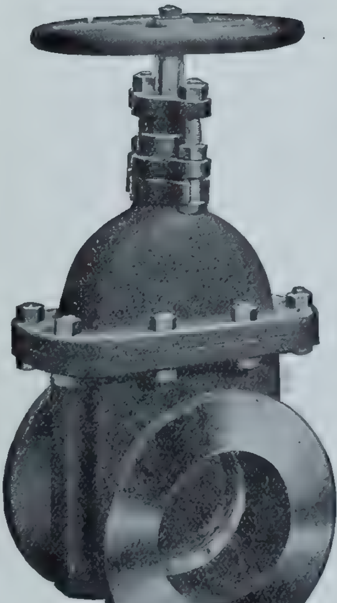


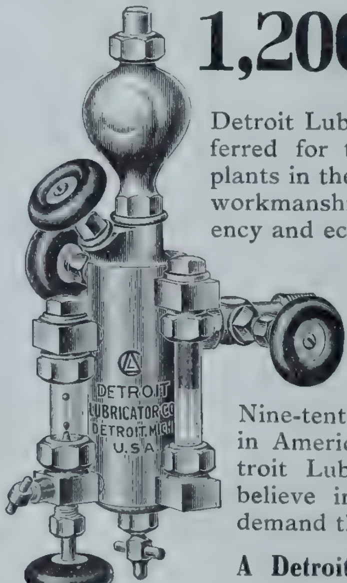
Kerr Gate Valves

are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

Write for our Catalog of High Grade Brass and Iron Valves.

The
Kerr Engine Co., Limited
Valve Manufacturers
WALKERVILLE - ONTARIO



1,200,000 IN USE

Detroit Lubricators have been preferred for the greatest industrial plants in the world because of their workmanship and durability, efficiency and economy.

Detroit Lubricators

Nine-tenths of the engine builders in America specify genuine Detroit Lubricators, because they believe in them and customers demand them.

A Detroit Lubricator will save you money, cause your engine to run better, prolong its life, and materially decrease your oil bill. Write to-day for Catalogue A-58 and full information.

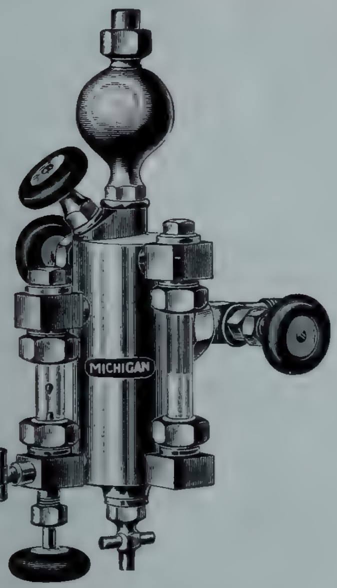
DETROIT LUBRICATOR COMPANY.

DETROIT, U.S.A.

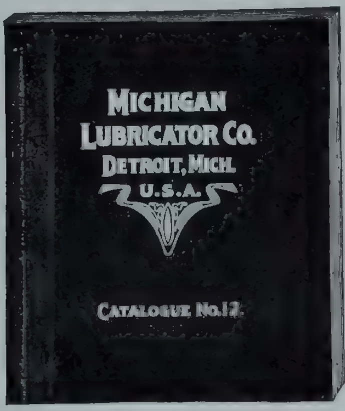
Largest Manuiacturers of Lubricating Devices in the World.

MICHIGAN

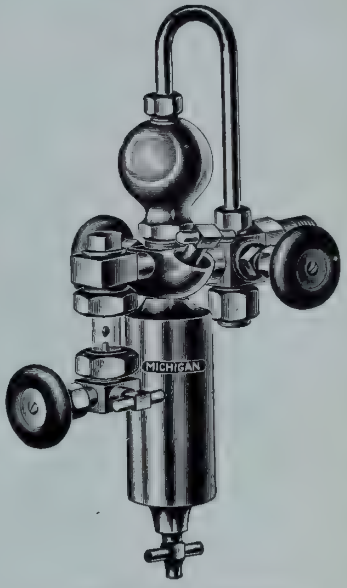
Illustrated catalog mailed to you free



Improved Double Connection.



WRITE TO-DAY



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MICHIGAN LUBRICATOR CO.

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The Richardson-Phenix Co.
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Appliances For Lubrication

Richardson Automatic Oil Pumps
Oil Filtering Systems
Phenix Force Feed Oil Pumps
Gang Oilers
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We Want You to Know

That We Manufacture

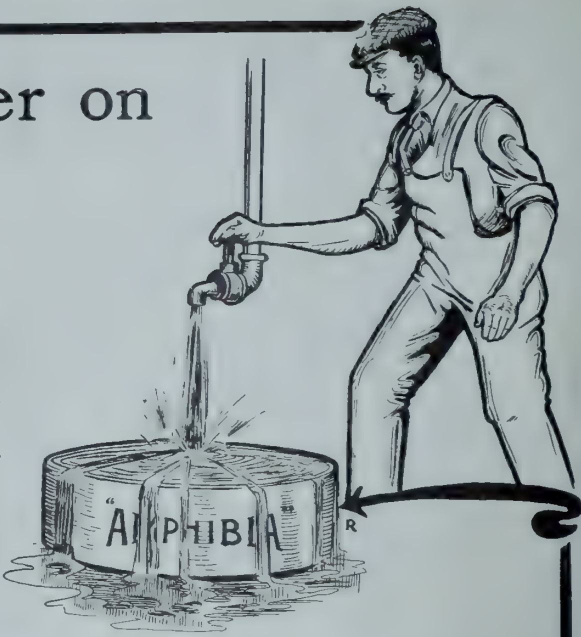
STEAM BOILERS OF ALL KINDS,
STRUCTURAL IRON AND STEEL,
HAND POWER CRANES,
PENSTOCKS, RIVETTED PIPE,
IRON and STEEL TANKS of all kinds and sizes, including water, oil or transformer tanks.
STEEL FIRE ESCAPES
STEEL LADDERS AND STAIRWAYS
AIR RESERVOIRS.

We are experts in the Oxygen-Acetylene process of welding, which we use largely in Tank work.

We would like you ***to give us a chance*** to supply your requirements in any of these lines.

International Marine Signal Co. Limited
Ottawa, Canada

You can turn the water on "AMPHIBIA" Leather Belting



Water will not injure "Amphibia." Neither will steam or moisture in any other form.

"Amphibia" is designed especially for use in any and every wet place. No matter how wet the place may be, "Amphibia" will stand up to the work and give long, satisfactory service. This fact is being demonstrated daily in hundreds of saw mills, steam laundries, cement plants, pulp mills, etc.

You try "Amphibia"---results will prove its merits.

Sadler & Haworth

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TORONTO, 27 Melinda St.
ST. JOHN, N.B., 89 Prince William St.
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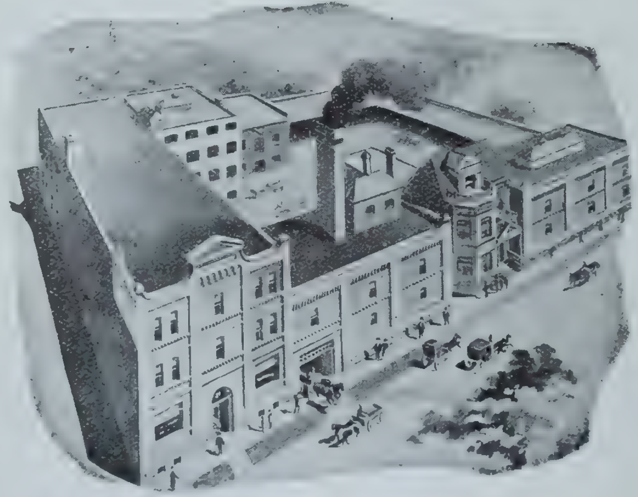

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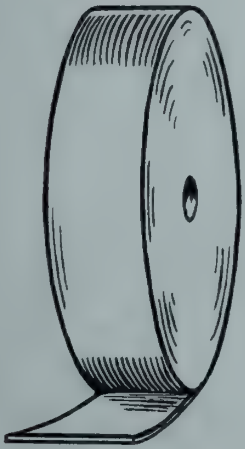

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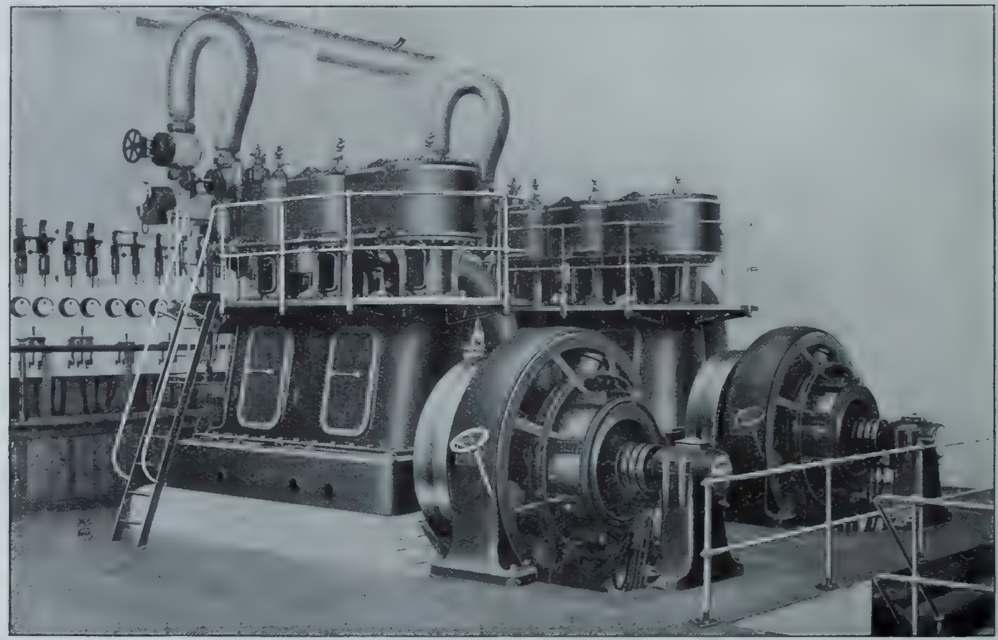

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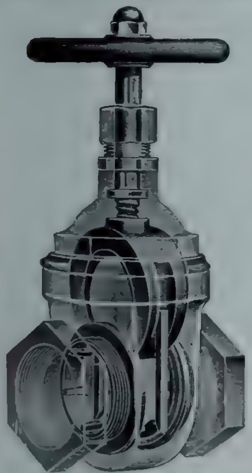

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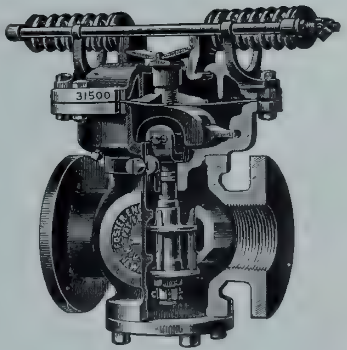

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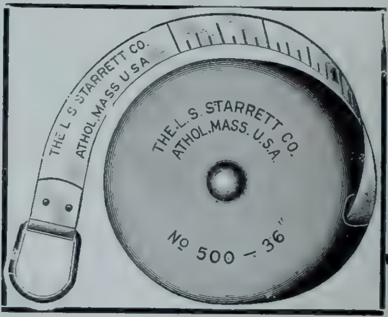
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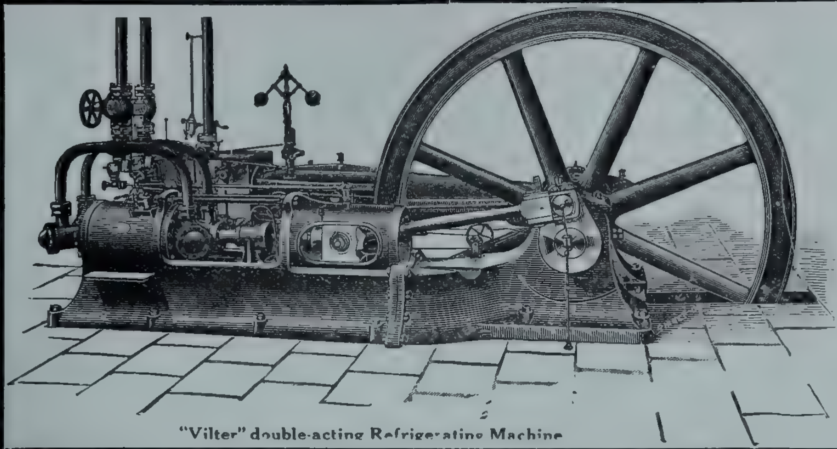

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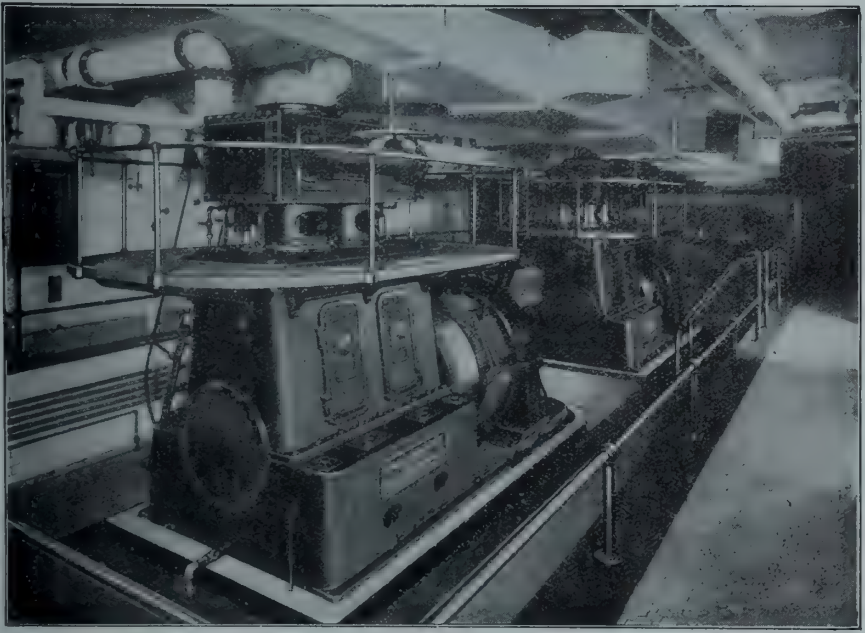

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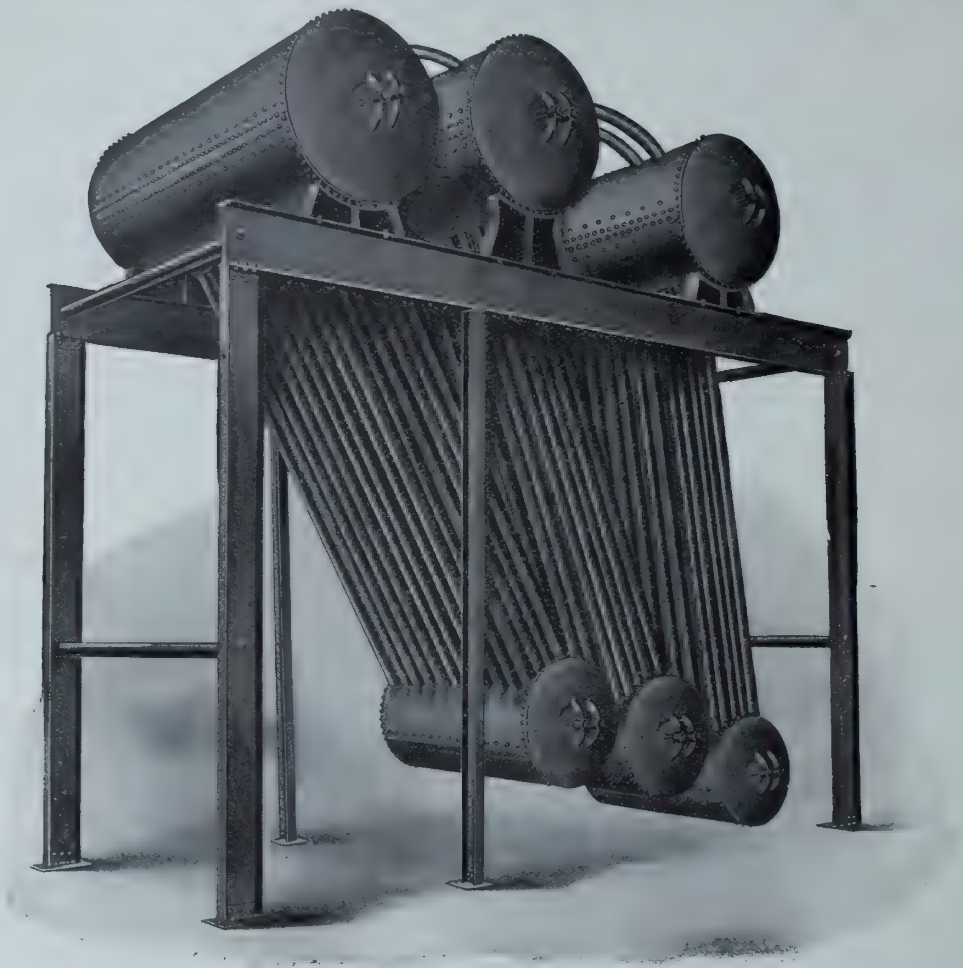

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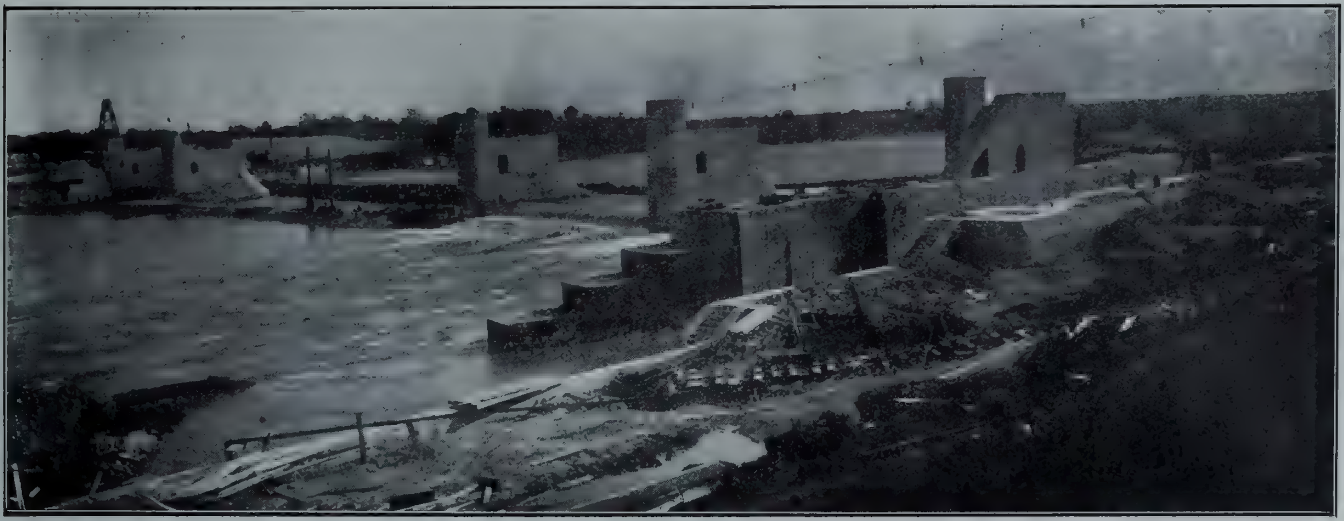

Substructure of St. Andrew's Dam Under Construction.

St. Andrew's Rapids Dam Across the Red River, Manitoba

Successful Structure to Increase Navigable Distance of the Red River—First Structure of its Kind in the Western Hemisphere.

By L. C. Harkness.

Some twenty years ago Colonel Ruttan, now Winnipeg city engineer, made an exhaustive study of the possibilities of navigation in Western Canada by way of the Red River, Lake Winnipeg and the Saskatchewan River. The report on this occasion made it clear that the construction of a navigable water course was feasible, and that the future of the country would warrant the interest of the Dominion Government in such an enterprize. The idea of carrying out the scheme lay dormant for years, but it was never lost; and not until 1908 did the Public Works Department take steps to develop the waterways of Western Canada.

It is only natural that the course nearest Winnipeg should receive the first attention and leading from that city it is proposed to open a ready course as far west as commercial interests would warrant the expenditure for the purpose, and this, at least, would lead to the City of Edmonton. The first difficulty to surmount was the St. Andrew's rapids, twenty miles north of Winnipeg on the Red River. It was these rapids alone that prevented vessels passing freely from Winnipeg to the Norway House, at the head of Lake Winnipeg, a distance of about three hundred and fifty miles. Should nothing further be done toward opening waterways west of the Norway House, the Government believed that the cost of constructing a dam and lock at St. Andrew's would be slight in comparison to the commercial advantages gained by the opening of the river and Lake route.

The Public Works Department made the necessary surveys of the gigantic undertaking, and submitted the plans and designs to the Canada Foundry Co. to carry out the work. In the spring of 1909 the operation began and at the present time one of the largest and certainly the most modern dams and locks in existence can be seen at Lockport, the new town on the Red River.

Description.

The dam consists of a substructure or permanent dam of concrete, on which is operated a movable dam, suspended from a service bridge of heavy steel frame construction. The dam is 788 feet in length, between abutments, consisting of six spans, each 119 feet 8 inches long, and five piers 14 feet in width. Altogether, some 25,000 cubic yards of concrete have been used in the construction of the dam, which was built in sections, and the stream so controlled that excavation was carried down to a solid stratum of rock, on which level the entire base of the dam was laid. The concrete dam raises the water to an upper level of 7 feet, and a further raise of 14 feet is accomplished by the suspended curtain dams.

Next to the erection of the concrete wall and piers, the steel bridge for the support of the curtain frames and the curtains, was the great feature of the construction. The reason for having an immense steel bridge may be seen when it is remembered that there are 90 steel frames, each weighing several tons, which are hinged from the bridge. Supported by each frame is a curtain, made of wood and heavily strapped and hinged with steel, which weighs about 1,200 pounds. When it is further remembered that each curtain dams one hundred and forty square feet of current water the strain upon the overhead steel work must be necessarily very great.

Leading Features.

The control of the frames and curtains by means of travelling electric cranes, operated from the service floor of the bridge is the leading mechanical feature of the structure. There are four steel tracks running the entire length of the dam, on which may be run the cranes, which control the frames, and which may be used to effect necessary repairs in the future.

At the end of the navigable season the curtains are rulled up, removed and stored away. The curtain frames are also raised up by the crane cables leaving the passage unobstructed for the removal of ice and the spring freshet. During the summer only occasionally will the cranes be brought into operation in manipulating the frames and curtains.

On the east side of the river is the power house and repair shop, in which the current is generated for the electric cranes. This building is 90 feet by 50 feet in dimensions, and is equipped with a 60 k.w. direct generator, attached to an 80 h.p. engine. The boiler which is

100 h.p. capacity, as well as all the machinery is supplied by the Canada Foundry Co. The Canadian General Electric Co. supplied the generator and the two small dynamos in use in the repair shop. There are three lathes in the shop, which will be used in making new curtains and repairing damaged sections of the curtains. These machines have been recently installed, and the machine shop equipment was tried out and everything ran smoothly.

View of Lock Chamber Looking up the River.

The power transmission was recently tested on the cranes in the bridge and the result was most satisfactory. There are four large cranes to raise the steel frames, and three smaller cranes for the curtains, and the manner in which they were smoothly manipulated was a source of satisfaction to those who were responsible for construction of the intricate work.

The Lock.

The lock between ends of extension walls is 290 feet in length, and 215 feet in length between hollow quoins, width 45 feet between vertical walls and total lift, or difference between elevation of lower and upper pools, 21 feet. A navigable depth of at least 9 feet at periods of lowest water will be maintained. The foundations are on the local magnesian limestone of Trenton formation. The walls of the lock are 37 feet in height and have a base width of 20 feet.

The side wall culvert system of filling has been adopted, there being a 5-ft. by 6-ft. culvert in each side wall with 8 ports of 2½ feet diameter leading into the body of the lock from each culvert. The filling and emptying valves are located above and below each set of lock gates and are automatic cylindrical valves, adapted from the Fontaine cylindrical valve used in France.

These valves are of special interest inasmuch as the working parts are not subject to pressures due to head and the valve will be therefore easy to manipulate under the maximum head of 21 feet.

The gates are of solid, built-up timber type, constructed of British Columbia fir, and northern oak, and are swung on gun metal pivots, which are anchored to the masonry by anchor bars imbedded in the concrete, it is expected that motors will be installed for the opening and closing of the gates, but at present this is done by a steel hand crank.

View of Dam With Curtain Frames Raised, Also Upper End of Lock Chamber.

OIL THAT COLD WILL NOT AFFECT

It is often difficult to keep machinery properly oiled in cold weather, as the oil freezes in the oil holes and the cups, and the oil upon the ways of the lathe and planer becomes stiff, causing the machines to work hard. A good oil for winter use is made by mixing graphite with cylinder oil until it is of a thick or pasty consistency, and then adding kerosene until it flows freely. This oil will not become stiff at 14 degrees below zero, and is valuable to those operating machinery outside or in cold shops.—Power and the Engineer.

Power House at St. Andrew's Dam.

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The Diesel Oil Engine

By Fred. H. Moody, B.A.Sc.

In view of the widespread interest in internal combustion engines of all kinds, it is strange that more attention has not been paid to the Diesel, which is an internal combustion engine operating along much the same lines as the usual four-cycle type, but with a few inherent differences, that appear to make for a better engine.

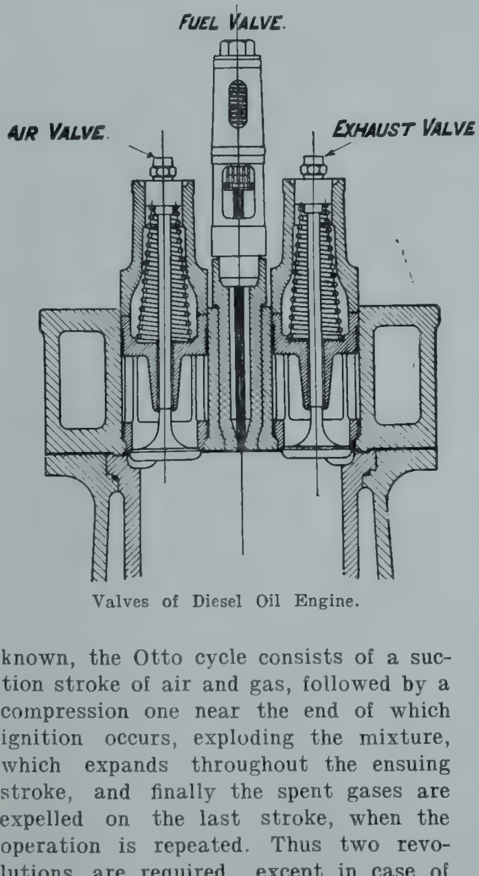
While this type of power seems to have come into its own very extensively in England and Germany and other parts of the world, but especially the latter country, where a very great number, indeed, are in operation, there seem to be very few on this continent, most of which are in the United States, for as yet Canada is with but one example—two ordered by J. B. McRae, consulting engineer, Ottawa, for a Moose Jaw plant.

Theory.

Sadi Carnot, the great French engineer, who was the first to lay down many of the laws of thermodynamics, in 1824 clearly defined a cycle of operation for the working fluid of any heat engine, the attainment of which would give the highest possible thermal efficiency for the limits of temperature between which the engine worked. To explain this cycle, two thermodynamic terms must be understood; viz., isothermal, and adiabatic, the former meaning constant temperature, and the latter, constant heat. Thus, if a gas be compressed isothermally, the temperature of the gas throughout this compression is constant. Similar reasoning shows that adiabatic compression of a gas means that the quantity of heat contained in the gas remains constant, which condition implies that the temperature undoubtedly rises.

In this theoretical cycle of Carnot's, there are four stages, (a) the gas is compressed isothermally, (b) next compressed adiabatically, (c) then expanded isothermally and (d) expanded adiabatically to its starting point, the operation (c) being made of such length as to ensure the latter point. Thus, summarized, Carnot's cycle consists of isothermal and adiabatic compression, followed by isothermal and adiabatic expansion, heat being withdrawn on the isothermal compression, and added on the isothermal expansion, the latter quantity of heat being greater, giving the resulting work. This cycle is the one all engineers try to emulate as it is the ideal.

The first commercial gas engine was that of Beau de Rochas, in 1862, which, while it didn't use Carnot's cycle, had the advantage of being practicable. This cycle of Beau de Rochas was developed in 1876 into a still more practical form by Otto, giving the very familiar cycle, the Otto cycle, on which most four-cycle engines operate. As just mentioned, it has the factor of practicability, which appeared to be lacking with the Carnot cycle. As is generally known, the Otto cycle consists of a suction stroke of air and gas, followed by a compression one near the end of which ignition occurs, exploding the mixture, which expands throughout the ensuing stroke, and finally the spent gases are expelled on the last stroke, when the operation is repeated. Thus two revolutions are required, except in case of scavenging engines, when air suction and expulsion strokes are included, making in all three revolutions or six cycles for this type.



Valves of Diesel Oil Engine.

It was left for Rudolf Diesel, a German professor, to make the first successful attempt at following the Carnot cycle. While the machine that he contemplated was not put on the market or even built, the patents and specifications for it were drawn up. As the specifications stated, his invention related to a process for producing power by means of heated air and gases, or a mixture of these in such a way that the combustion takes place isothermally, and that the following expansion should be adiabatic, reducing the temperature to that of the atmosphere. He contemplated regulating the temperatures of the gases in the cylinder, by the injection of too much air, so that water jackets would be unnecessary, thus doing away with this very wasteful feature. The fact that the spent gases were to be atmospheric when discharged eliminated another large loss. The weakest feature lay in the fact that pressures as high as 250 atmospheres were projected, with water injection to the cylinder, and 100 atmospheres without. the water to keep down the temperature of the compressed air to make first part of compression isothermal.

Thus, it can be seen that the idea, if carried out, had the Carnot cycle very closely followed. However, this cycle from a mechanical standpoint had many weaknesses, especially as several separate cylinders were required, the first cylinder being used to compress the air isothermally by water injection, the second to compress adiabatically and so on. In order that isothermal combustion might be made possible, experience showed that the quantity of fuel burnt must be very small in relation to the air in the cylinder, giving a small amount of power proportionately to the size of the cylinder. The fact that expansion was to atmospheric temperature made the stroke unduly long, the latter part of it yielding but little power, thus tending to increase the size of the engine.

Actual Cycle.

The foregoing cycle, which was contemplated on the original Diesel engine, was for the practical reasons mentioned, changed, so that now it varies considerably from the theoretical cycle emulated. But this is but natural, as engineering feats are as a rule compromises between theory and practicability. As now made, the first stroke, the suction stroke, draws in plain air (not air and gas or vapor) which is compressed throughout the whole of the following stroke. These are all shown in Fig. 1, At the end of the stroke, when the air pressure is highest, oil is sprayed in, which ignites, and burns, not at a constant temperature, but as practice shows, at a very nearly constant pressure, through part of the ensuing stroke, and expand during the remainder of the stroke, the gas not being expanded to atmospheric conditions, but at a pressure considerably above, when it is expelled the loss in power being more than offset by the mechanical gains, in the same manner as a steam engine releases at a higher pressure than exhaust. During the last of the four strokes, the spent gases are ejected.

From this, it can be seen that the cycle while in general, like the Otto, has several distinctive features. To attain the high pressure necessary to ignite, a smaller percentage of clearance is essential. This pressure at the end of the stroke, has been determined from many experiments, to be best at from 450 to 500 pounds per sq. in. This creates sufficient heat to ignite oils of the highest flash points that would be used.

The curve followed on compression is very nearly adiabatic, as but little heat can escape on the usual quick acting engine. Reference to Fig. 2 shows from actual experiment, about what the compression curve is like. A B is isothermal, i.e. constant temperature, while A C is adiabatic. The actual curve lies between, though much closer to the adiabatic than the isothermal. If the adiabatic were followed, compression to 500 pds. from 60 deg. F. would result in a temperature of 1,110 deg. F., while from the Diesel compression, by actual computation, for 500 pds. per sq. in., the temperature would be 947 deg. F. Experience has shown therefore that from 450 to 500 pds. meets the needs of the worst oils, of slow running, and cold circulating water, as most oils have a much lower flash point than this.

The fact that just air and not an explosive mixture is compressed has several strong points in its favor. It has been found from long experience, that in internal combustion engines generally, the greater the initial compression, the greater the efficiency. The Diesel with its 450 pds. has an advantage over the gas engine with from 175 to 200. If these latter figures be exceeded, premature explosion may occur, causing greater strains in the engine than it was designed to withstand. Then again, a piece of red hot carbon, or a heated projection of the cylinder tend to cause premature explosion where a combustible mixture is compressed.

The really strong feature of the Diesel lies in its firing, for, as the oil takes an appreciable time to be injected into the cylinder, corresponding time is taken for the mixture thus formed to ignite. In place of the sharp explosion as with gas engines resulting in a maximum temperature and pressure practically instantaneously, in the Diesel engine, the burning being slow results in the temperature, using but little, while the pressure rises not at all, making the final pressure of compression the highest pressure in the cylinder. This assists towards easy running. Fig. 1 shows how like a good steam card the diagram from the Diesel cycle is, for the ignition line corresponds identically in both cases. When complete combustion has occurred, expansion takes place, followed by the exhaust.

The absence of sparking device, hot tube, or other mechanism for igniting is a strong feature, as it is here that much of the difficulty experienced in the usual Otto Cycle engine occurs. In addition, the slow ignition before mentioned keeps down the temperature, so that, while the pressure is greater than with a gas engine, the temperature is less.

As the oil does not require to be vaporized before injection, being merely sprayed in, thick heavy oils may be readily used, thus allowing the use of crude oil where lighter oils are required with ordinary oil engines working on the Otto Cycle.

Governing is effected by regulating the supply of oil to the engine, thereby reducing the area of the card. The sensitiveness of the device is shown by reference to Fig. 3, which shows what the variable load governor will do.

Construction.

Fig. 4 illustrates the latest type "Mirrless-Diesel" oil engine, built by Nurrlees, Bickerton & Day, Stockport, for whom the Canadian Boving Co., Toronto, are agents. Most companies manufacturing the Diesel build them vertical, so this serves as an example of them all. Fig. 5 shows a sectional view, as originally constructed, the air compressor, which is now driven direct from the shaft, as shown, was built on the side of the machine, and operated by means of a rocking lever connected by a link to the main lever, but as this introduced side strains and involved the use of many small wearing parts, the practice was discontinued.

As will be noticed all the valves are placed on top of the cylinder, minimizing clearance space. The inlet and exhaust valves are of the usual "mushroom" pattern, operated by cams, the seat and all being made removable, avoiding the necessity of leaving the engine idle, while grinding in the valve. A spare valve and valve seat, supplied with the engine obviates all this. The removal of the valves is facilitated by the levers being so constructed that one half can be easily swung back.

The fuel to be injected into the cylinder is pumped into a receptacle on the cylinder cover, by means of an ordinary plunger pump, the quantity pumped being decided by the governor. If the load on the engine increases, the speed falls slightly and the governor weights move inward, and in so doing, by means of special mechanism, cause the fuel pump to deliver an increased quantity of oil to the cylinder, thus giving more power to meet the load. In a similar manner, increases in load are met. The regulation of the quantity of oil pumped is effected very simply, as shown by reference to Fig. 6. The governor holds up the suction valve of the pump during part of the stroke according to the load on the engine. The Mirrless-Diesel supplies a pump for each cylinder, while other manufacturers make the one pump answer for them all. This latter system does not give as good distribution.

Fig. 7 shows the valve arrangement. The chamber or receptacle into which the fuel is pumped is connected with the compressed air supply, the pressure of which exceeds the highest pressure obtained in the engine cylinder. From this chamber there is an outlet leading into the cylinder, controlled by a small valve, the fuel valve. Just above this device is a small valve called the "pulveriser," into a chamber above which the oil is delivered with the result that when the fuel valve is opened the oil is forced in by compressed air through the pulveriser into the cylinder, which it enters in the form of a fine spray. Experience shows that a pulveriser suitable for residual petroleum oils which are very viscous, will also suit for less sticky oils, thus requiring but one pulveriser

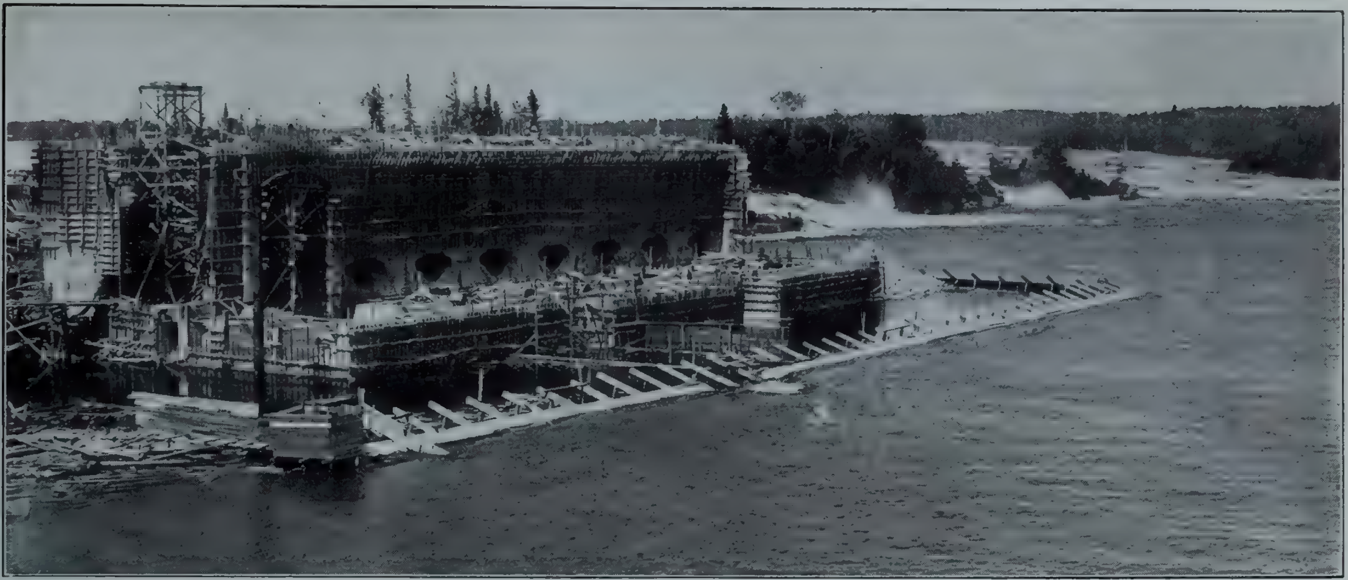
Starting is obtained by means of compressed air, for the cylinder is fitted with an extra valve, called a starting valve. This starting valve, like the other valves, is operated by a cam, and an arrangement is fitted to the engine, whereby it is impossible for the starting valve and fuel valve to be in operation at the same time.

Economy.

From the viewpoint of fuel economy, the Diesel ranks very high, one feature being that the economy varies but little with the size of engine. From a theoretical standpoint, it is obtaining a very high perfection, as a thermal efficiency as great as 41 per cent. is practicable.

In conclusion, very low operating costs are the rule, for at full load a fuel consumption of .45 pounds is guaranteed, and .70 pounds at ¼ load.

In addition, the standby losses are nothing, as absolutely no fuel is in use when the engine is not in operation, thus introducing a considerable saving.



View of First Section of the Big Municipal Power House, Point du Bois; 60,000 horse Power Will Furnish Winnipeg With Light and Power.

Winnipeg's Municipal Power Plant at Point du Bois

How the Gateway City is Making Sure of 60,000 Horse Power for Domestic and Business Purposes—Description of Dam, Power House, etc.

By Charles F. Roland.

The Winnipeg power plant at Point du Bois, on the Winnipeg River, is progressing favorably towards completion. Winnipeg is building a power plant capable of producing 60,000 horse power and this to be added to a plant already operated by the Winnipeg Electric Street Railway and capable of supplying some 30,000 horse power for Winnipeg users of electric power.

Power in the west is, speaking generally, most cheaply developed from water power. There are large coal areas in the prairie provinces, but these are chiefly in British Columbia, southwestern and northwestern Alberta, practically a thousand miles from Winnipeg and the older parts of the West. Fortunately, the rivers are swiftly flowing streams and the Winnipeg river appears to have been made to order for power purposes. The fall at Point du Bois forms one of the great water power sources of the world and the work done there to connect this power for use in Winnipeg has been of a character to give the city a splendid power plant which will be in operation within a year.

The total cost of this plant will be $3,250,000. There are 425 men now employed and the work is pushed by night and day, shifts working ten hours each. The cosmopolitan character of Western Canadian population is typified in the working force at Point du Bois of whom 250 are Galicians, 50 Italians, 90 Swedes—all carpenters—and the balance English-speaking.

Sixty thousand cubic yards of rock have been taken out in course of the work that has been done and 34,000 yards of concrete have been put into the construction of the plant. It has taken $18,000 worth of dynamite to make the rock excavation and with the concrete gangs in full swing, 1,600 sacks of cement are mixed each day. The contractors are John Gunn and Sons, of Winnipeg, and the engineers the well-known firm of Smith, Kerry & Chace, of Toronto.

A town is growing up around the power plant and sixty or more houses—mostly of log construction—have been built. The engineers' staff have a fine house with all modern improvements and the town and works are lighted at night by a small plant that has been adopted for this use. There is a school for the village children and one of the purely local results of the Point du Bois plant will be the establishment of an enduring settlement in this place which would have been a wilderness in the woods otherwise.

Transportation Requirements.

To supply the transportation needs of the power plant, a railroad has been built, road and equipment being the property of the City of Winnipeg. The city owns a right of way from Winnipeg to the plant 150 feet wide and 60 miles long. This right of way, part of which was bought from the Dominion Government at the rate of three dollars per acre, will prove to be immensely valuable in time, since the natural beauty and woodsy wilderness of the scenery about the Point du Bois plant is sure to make the place a popular summer resort as Winnipeg grows and its population pushes out into the country to enjoy the incomparably fine Manitoba summer to the full. Fish and game are plentiful and the place as a whole is admirably constituted by nature for a summer resort.

From a fully practical standpoint, the Point du Bois site is equally well chosen. The falls have a natural drop of thirty-three feet and volume of water sufficient to develop 100,000 horse power when the last word has been said.

Inducements to Industrial Plants.

The first installation will be of 20,000 horse power and the city government has plans for adding other inducements to the cheap power which will be afforded manufacturers when the big plant shall have been put in operation. These plans include a fixed assessment for a term of years and the acquisition, by the city, of a large tract of land which will be held for factory sites only and will afford manufacturers who desire to secure a site in Winnipeg, the chance to do so without being subject to hold-up prices or the wastefulness of inconvenient location. Operation of the civic power plant means, too, that cheap

Point du Bois Power Scheme Being Inspected by Winnipeg Council and Board of Control.

power and light will be available for all purposes to which these items of domestic use are applied.

Winnipeg's Progress.

The special and incidental economies that must result thus, are hardly determinable in figures but they cannot fail of being very great. Industrially, Winnipeg has made rapid progress within a few years. In 1901, the value of local manufactured products was $8,606,248; in 1906, the figures had grown to $18,983,248, and the value of Winnipeg manufactured for 1910 is placed at $25,000,000. An industrial census, completed within the past month, shows that there are 185 factories in Winnipeg as against 146 in 1908. There are a number of new industries that soon will be added to those already established, among them being two gas traction engine works, a tannery, a cereal mill, a stove foundry and straw board works.

Induced by plentiful raw materials for certain lines of manufacture and by a splendid demand for goods of all kinds and at all times, manufacturers from the United States, Great Britain, Eastern Canada, France, Belgium, Holland, Germany and other countries are showing great interest in Winnipeg as a site for profitable expansion of industries already established elsewhere, or the setting up of new ones. In this work, the big municipal power plant is to be a factor of great strength and importance. Beyond a doubt it will mean thousands of people added to the city's population, many thousand dollars saved to Winnipeg people and millions added to the manufactured output.

An important function that the civic power plant will perform for Winnipeg—and for the people of Canada—is that of furnishing light and power for Canada's great International Exposition and Selkirk Centennial to be held in Winnipeg in 1914.

Point of Canal Wall, Adjoining East End of Power House, Point du Bois—a Municipal Work that Will Cost $3,250,000 to Complete.

Miniature Model of the Point du Bois Plant. Exhibited by Winnipeg at the Winnipeg Industrial Exhibition.

The proposal to hold an International Exposition at Winnipeg in 1914, having been placed before the people and press of Canada, has received the endorsation of general meetings, Boards of Trade, and of editors throughout the Dominion. It will create and open up many outside markets for a great variety of our products and manufactures in countries which at present know nothing of our capabilities. The holding of such an Exposition will show what Canada had done and is capable of doing and will supply a concrete object upon which all Canadians can unite in making a worthy display of the wealth and worth of Canada.

It will mean the making of long strides forward towards the goal of national greatness which is to be Canada's through the development of natural resources richer than those of any new country in the world.

ECONOMY FROM SUPERHEATED STEAM.

The principal reason that superheated steam is used, is because it largely avoids cylinder condensation. In the case of an engine using saturated steam no heat can be taken from that steam, to heat up the steam passages, cylinder cover, cylinder walls, and piston, cooled by the previous exhaust, without partially condensing, to furnish by its latent heat of evaporation, the necessary heat, thus rendering a considerable portion of the steam incapable of doing useful work. This condensation, while greatest during admission, continues during expansion till the temperature of the expanding steam is of the same temperature as the cylinder walls, when the process is reversed, and heat is then abstracted. This latter continues throughout the remainder of the expansion, and during the exhaust. While beneficial during the latter part of the expansion, it is otherwise during exhaust as the condensed water is re-evaporated by the heat previously transferred to the walls from the original live steam, and escapes through the exhaust, doing no useful work, but on the other hand producing greater back pressure, thereby proving more detrimental.

In this process of re-evaporation, the water which has been deposited over the surface of the cylinder in a finely divided state, abstracts heat very rapidly owing to its very close contact with the metal, and while evaporating, it can abstract a large amount of heat without its temperature being raised at all, the heat becoming latent—the latent heat of evaporation—which for atmospheric steam means 966 B.t.u. per pound. The very fact that water is in a finely divided state over the cylinder walls, forming a film, tends to promote the heat interchange, as water has great conductivity.

With regard to the extent of the loss due to heat transfer, Kent quotes Rankine to the effect that conduction of heat to and from the metal of the cylinder, or to and from the liquid water contained in the cylinder, has the effect of lowering the pressure at the beginning and raising it at the end of the stroke, the lowering effect being on the whole greater than the raising effect. In some experiments, the quantity of heat wasted through alternate liquefaction and evaporation in the cylinder, has been found to be greater than the quantity which performed the work. Dr. Schmidt another eminent authority, states that the steam usefully employed in the cylinder is from 30 to 50 per cent. less than that actually supplied, these figures also representing the amount wasted.

Superheated steam is advantageous in two ways in preventing this condensation—firstly, because it is a bad conductor of heat, and therefore causes the heat interchange to be less than with saturated steam, and secondly, because, if steam be of a sufficiently high superheat during admission, the only effect will be a reduction of its volume and superheat, while it is still left capable of doing useful work. The underlying idea to be emphasized is the absence of the water film, which acts as the conductor of the heat from the steam to the walls, and vice versa. The dry superheated steam being such a poor conductor of heat reduces the transfer greatly.

The evaporation of the water condensed when using saturated steam on the exhaust stroke, is the principal cause of the reduction of the temperature, and therefore of the heat contained in the cylinder walls, and by avoiding this variation in temperature with superheated steam by preventing the condensation, which as before pointed out, transmits the heat to the walls, thereby diminishing the heat-transfer.

From experiments made by Prof. Ripper, on a small Schmidt engine, he found that for every per cent. of wetness at cut-off, 7.5 degrees Fahrenheit of superheat were required to insure the steam being dry at that point. From this, by simple illustration we can see how much the heat-transfer by the use of superheated steam, can be avoided. 1 p.c. moisture in the steam means 1 p.c. of the latent heat of evaporation of the steam has been transmitted to the cylinder walls. This, in the case of 100 pound steam means 883.3X.01 equals 8.83 B.t.u. Assuming a value of Cp. equals .5, which is near enough for the purpose of the example, the heat lost to the cylinder walls for every per cent. of moisture would be 7.5x .5 equals 3.75 B.t.u. Thus, in the case of saturated steam, the heat-transfer is

$$\frac{8.83}{3.75} \text{ equals } 2.35$$

times as great as with superheated steam.

Another series of experiments were performed by Prof. Ripper, with various degrees of superheat, and by means of Hirn's analysis, discovered the amount of heat missing at cut-off for these different amounts of superheat. Fig. 1 shows these results plotted for three different amounts—high, medium and no superheat. It will be noticed that for high superheat, the heat missing, which is plotted in foot-pounds to conform with the indicator cards, is almost the same as the work done, showing that there is little heat transferred to the walls from the steam. With medium and no superheat, the shaded area shows how great the heat interchange is, increasing as the superheat decreases. These results were all obtained from the same engine, under similar conditions of load and speed. Many experiments by different investigators all tend to show that the heat exchange is much increased with the wetness of the steam and decreased with longer cut-offs, and higher speeds, thus still further proving the statement that by reducing the presence of moisture, the heat exchange is diminished.

Prof. Doerfil, another investigator, found in a certain case, that with 25.5 deg. C. of a superheat, the heat exchange during admission amounted to 2106.5 calories, whereas, when the superheat was reduced to 142.5 deg. C., the heat exchange amounted to only 480.6 calories.

Assuming from what has just been stated that the heat exchange is less with superheated than with saturated steam, the Temperature-Entropy Diagram will give an interesting graphical means of seeing how the economy is greater. Fig. 2 represents the temperature-entropy diagram for a cycle of one pound of superheated steam, working between pressures p. and p2, which have the corresponding temperatures, ts. and ts2. From the before mentioned results that 7.5 deg. F. of superheat are required for every per cent. of moisture in the steam at cut-off in order to have dry steam at that point, 50 p.c. moisture would require a superheat of 375 deg. F. This means that, by the addition of the small heat area under the constant pressure superheated curve, the larger area under one-half of the constant pressure saturated curve is obtained.* That is, with saturated steam having 50 p.c. moisture, the amount of heat represented by the area o deg. abcdeo deg. is added to obtain the smaller area bcfg in useful work, while with steam dry at cut-off, by the use of superheat, the slightly large area o deg. abcdsto deg. gives the proportionately larger work area bcdh. This shows graphically what an improvement is obtained. For other percentages of moisture, different degrees of superheat are required as shown. Thus, for 40, 30, 20 and 10 per cents of moisture, 300, 225, 150 and 75 degrees of superheat respectively, are required.

When steam is superheated beyond the point at which dry steam is present at cut-off, a still further gain occurs on account of the decreased heat exchange up to the point where it is dry at release, which requires an increase in the superheat of from 50 to 100 degrees, according to the rate of expansion and other conditions, but where an economical rate of expansion is employed, super heat is rarely carried to this point. However, it is not a loss, but rather a gain, to have steam still superheated at release, due to the advantage of a working fluid which may be used at high temperatures and without excessive pressure.

According to the Mechanical World a cement which is effective for cementing rubber to iron, and which is specially valuable for fastening rubber bands to bandsaw wheels, is made as follows: Powdered shellac, one part; strong water of ammonia, ten parts. Put the shellac in the ammonia-water and set it away in a tightly closed jar for three or four weeks. In that time the mixture will become a perfectly liquid transparent mass, and is then ready for use. When applied it forms a firm bond.

Safety Stop on Engine Insures it Against Breakdown

Value of Equipping an Engine with an Automatic Engine Stop, with an Illustrated Description of the Strong Automatic Engine Stop.

In Canada and the United States there have been 3,000 flywheel accidents during the past year. By a simple contrivance these accidents could have been avoided. As there is a possibility of accident wherever there is an engine, the automatic engine stop is really an insurance against life and the engine itself.

The prevention of accident to the engine means the saving of the time of a great number of men in the factory. With an automatic engine stop the engine is brought to an immediate stop in case of a racing flywheel, thus saving days and even weeks, while the damage is being repaired, and a new flywheel is being made.

An interesting device was shown in operation at the Berlin convention of the Canadian Association of Stationary Engineers, for eliminating the danger of a broken flywheel. This machine is manufactured by Strong, Carlisle & Hammond, Cleveland, is simple in operation, and very efficient.

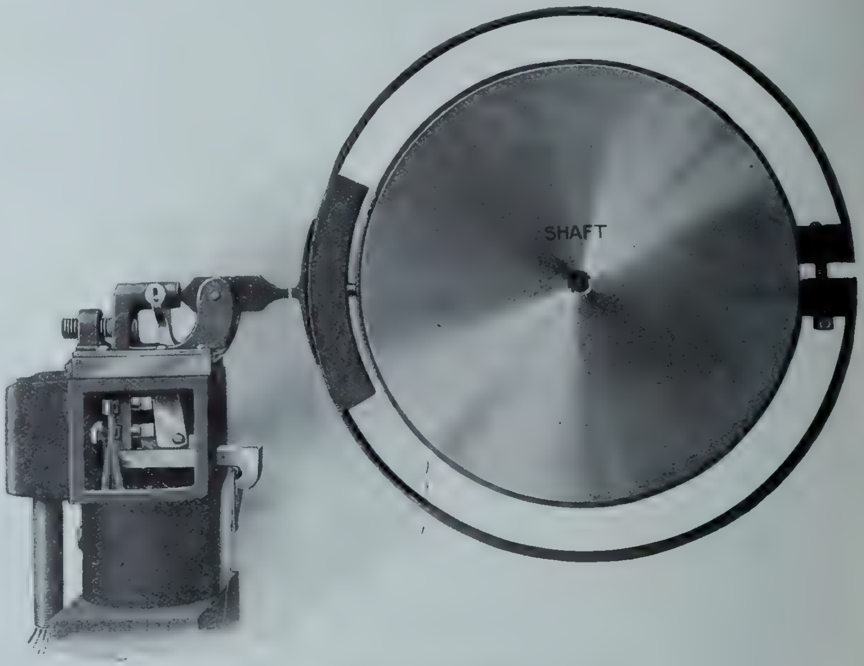
Strong Automatic Stop.

The construction of the Strong quick-closing valve is shown in Fig. 1.

In Fig. 2 is shown the tripping device front view, cover removed, showing magnet, hammer, lock pin and valve rod handle in place. The hammer released strikes block that knocks out valve rod. The cam on hammer hub pushes the lock pin behind block (see Fig. 3).

Fig. 3 shows the tripping device, front view, cover removed, hammer released, lock pin down, valve rod dropped. It is impossible to start the engine without opening the quick-closing valve. The valve cannot be held open at tripping head without resetting the tripping device.

Fig. 4 shows tripping device, back view, with attachment for mechanical



Fib. 5.—Speed Limit Clamped to Shaft.

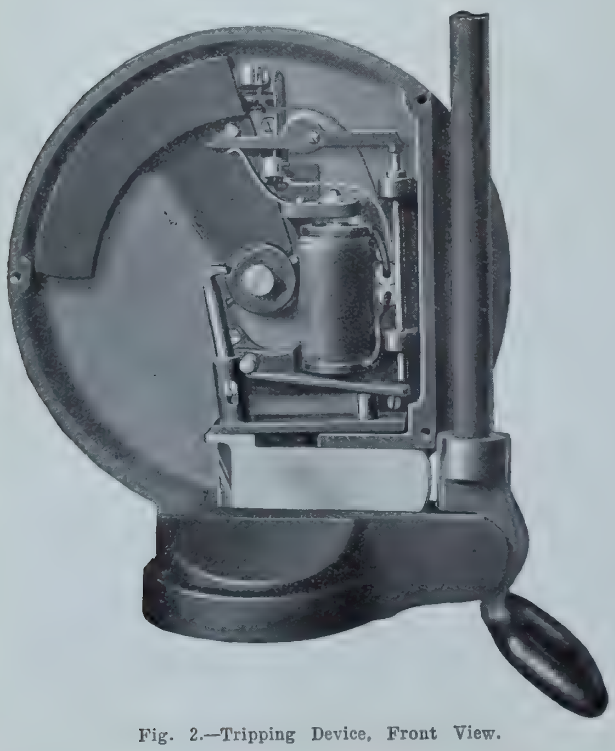


Fig. 2.—Tripping Device, Front View.

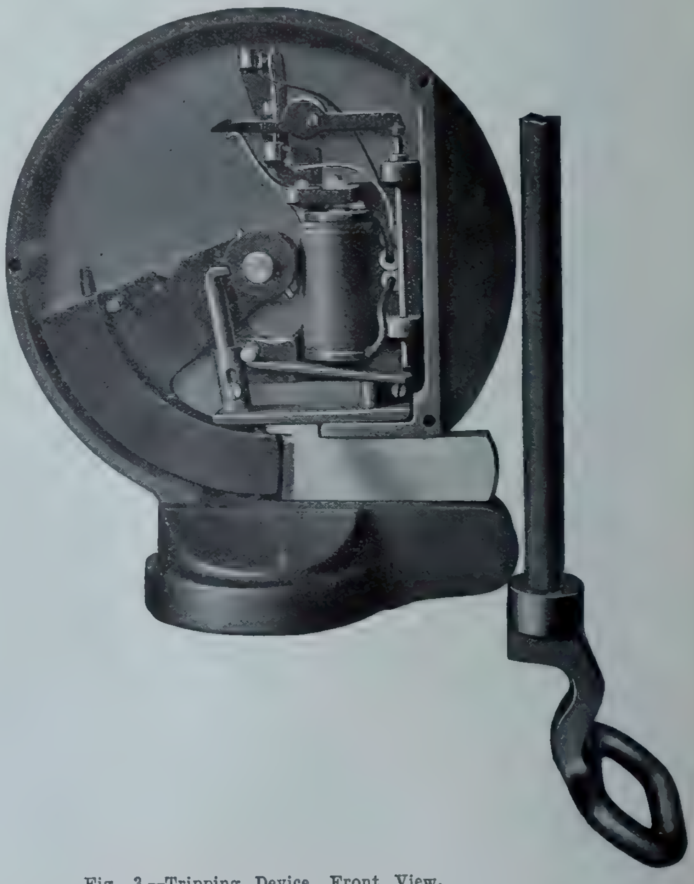


Fig. 3.—Tripping Device, Front View.

tripping. Cable is placed in ⅜-inch brass tube. Trip latch, resetting knob, wires are plainly shown in conduit. There are conditions calling for purely mechanical operated engine stop. This attachment is simple and easily applied. The conditions are wet engine rooms, acid fumes, etc.

Fig. 5 shows speed limit clamped to shaft, together with device for making electric contact and releasing mechanical attachment for closing stop valve. Cover is removed to show electric knife contacts. The clamping blocks show plainly with the steel spring securely fastened to them. The weight fastened to this spring with pin holding same from lateral motion. As the engine exceeds its normal speed this weight causes the spring to elongate and come in contact with the trip latch. This is held in position by piston backed by coiled steel spring in the barrel; thus it will be readily seen that it makes no difference which way the engine runs.

The travel in this barrel moves the yoke forward. This makes electric contact inside of the head, also release the cable if mechanical attachment is used. Trip latch is moved forward or back by screw behind the barrel. Once this trip is set the marking will show at a glance if trip has been moved forward or back. The absence of belt or gear makes this a most reliable speed limit. It cannot get out of commission without stopping

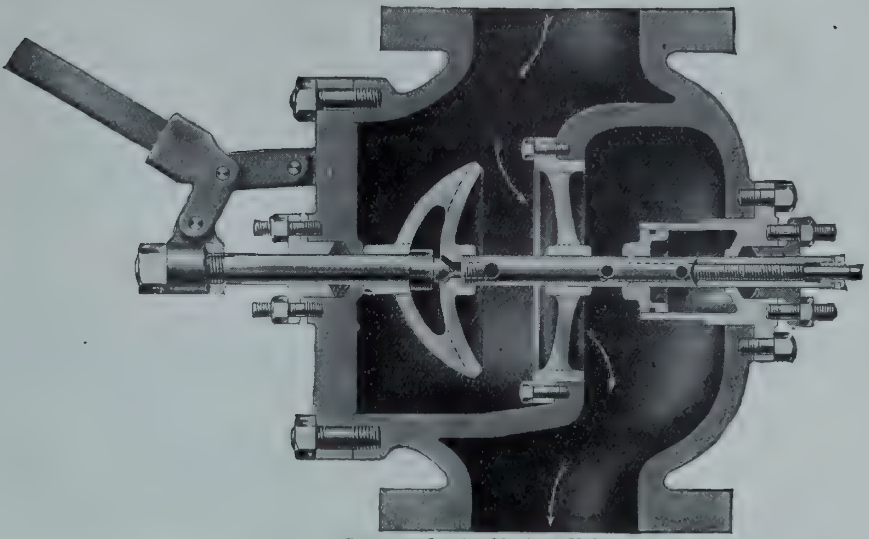


Fig. 1.—Strong Quick Closing Valve.

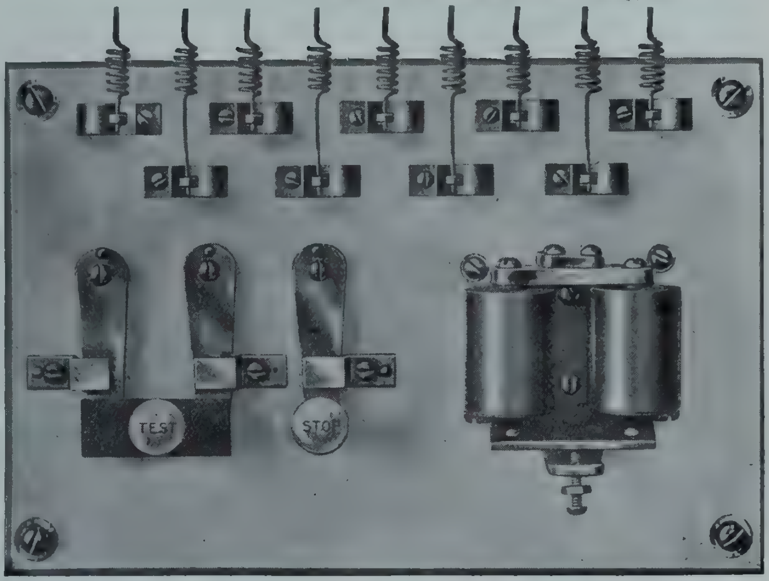


Fig. 6.—Terminal or Test Board.

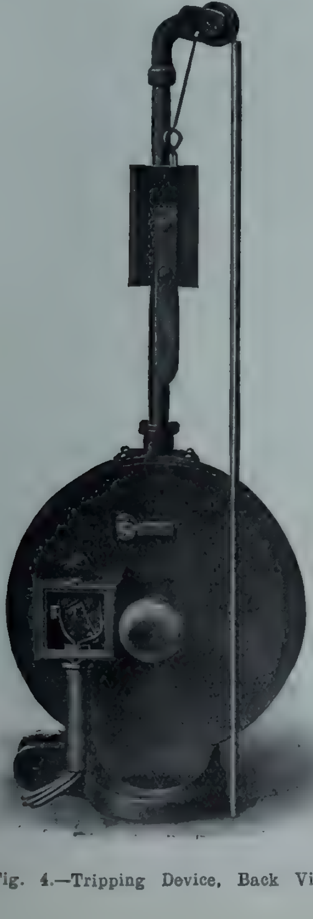


Fig. 4.—Tripping Device, Back View.

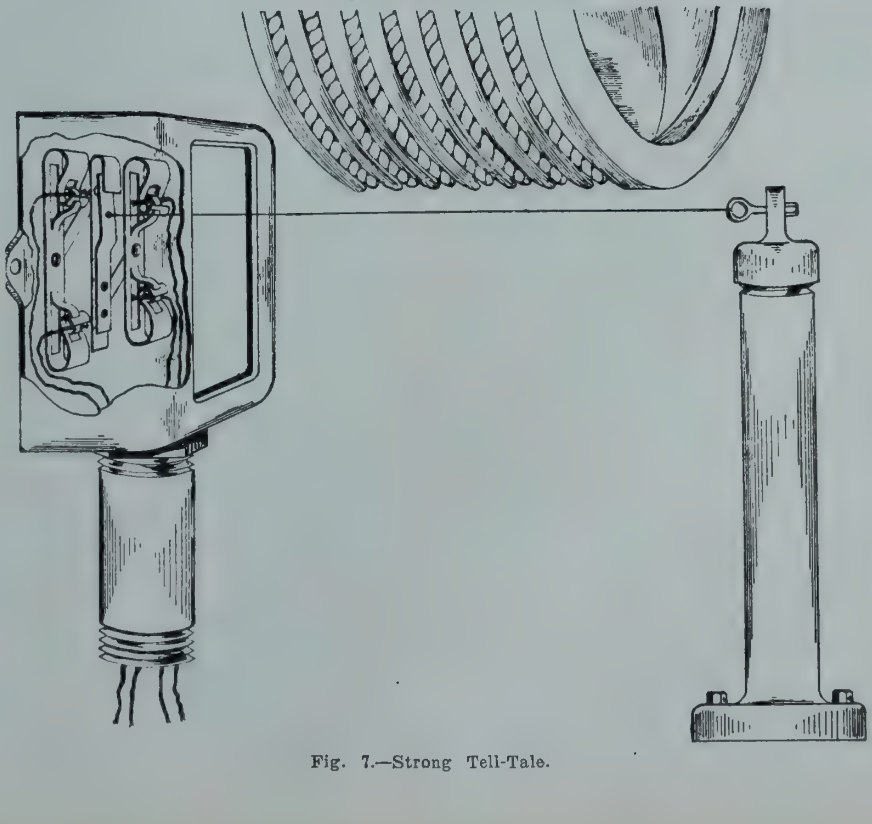


Fig. 7.—Strong Tell-Tale.

the engine. This is another desirable feature.

Fig. 6 shows the terminal or test board. It is white marble, 6'' x 9'' x 1''. The terminals are spring clips. Test key, stop key and magnets are in circuit only when test key is depressed.

Fig. 7 shows the Strong tell-tale. A fine copper wire is stretched in front of the rope holding the electric circuit open. Should a rope strand, the wire is broken and the alarm sounded. Should the wire pull instead of break, the circuit is closed by back contact. These tell-tales are sometimes wired in the automatic engine stop line so that a rope stranding closes the quick-closing valve, thus stopping the engine.

The English type of rope transmission requires only one tell-tale, while the United States' systems calls for two, one for strand, the other at the tightening carriage in case the pulley breaks or the carriage gets loose.

Incorporation and Licensing Engineers in Manitoba

A Bill has been Passed by the Manitoba Government Respecting the Incorporation and Licensing of Stationary Engineers in Manitoba.

His Majesty, by and with the advice and consent of the Legislative Assembly of Manitoba, enacts as follows:

1. This Act may be cited as "The Steam Engineers."

2. In this Act, unless the context otherwise requires:

(a) The expression "owner" means and includes any person, firm or corporation, the owner or lessee of a boiler, and the manager or other head officer in charge of the business of any such firm or corporation;

(b) The expression "engineer" means any person having charge of, or operating a steam boiler or the steam engine connected therewith, either separately or combined, under the provisions of this Act;

(c) The expression "board of managers," or "examining board," means a chief examiner and two assistants appointed under the provisions of this Act;

(d) The expression "certificate" means the provincial, final or interim certificate of qualification issued to an engineer under the provisions of this Act.

3. W. R. Cahoon, R. J. Buchanan, J. Mills, W. Pullman and John A. Fraser, and their successors, appointed as hereinafter prescribed, and shall be and remain a body politic and corporate by the name of "The Manitoba Association of Stationary Engineers."

The persons named in Section 3 shall be the directors until the first annual meeting, which shall be held on the first Tuesday after the first day of September, 1910, at an hour and place to be fixed by the directors, of which they shall give due notice to all the members.

4. The persons composing the said corporation shall be those to whom certificates may be issued under the provisions of this Act.

5. The said corporation shall be the said name, have perpetual succession and a common seal. with power to change, alter, break or make new the same, and by the name aforesaid may sue or be sued, implead and be impleaded, answer and be answered unto, in all courts and places whatsoever, and may have, hold, receive, possess and retain for the purpose of this Act, for the use and benefit of the said "Association of Stationary Engineers," all such sums of money as may at any time be given or bequeathed to and for the use of "the said Association," and by the said name may purchase, take, hold and enjoy, any real estate, or any estate or interest derived or arising out of real estate, for the purpose of "the said Association," but for no other purpose, and nothing herein contained shall give the said association any right or power to deal or traffic in land, except for the purpose above mentioned, and it may sell, grant, lease or otherwise dispose of such lands as it is entitled to acquire and hold under this Act, but the real estate so held by the corporation for its own use shall at no time exceed in value the sum of Fifty Thousand Dollars.

6. The affairs of the said "The Manitoba Association of Stationary Engineers" shall be managed by a board of directors, five in number, who shall be elected by the members of "The Manitoba Association of Stationary Engineers" generally, and at each election, which shall be held every year, every member of the said corporation shall have the right of voting personally.

Examining Board.

7. There shall be an examining board, composed of three persons appointed by the Lieutenant-Governor-in-Council from year to year, and such board shall determine the qualification required of candidates for the several classes of certificates under this Act, prescribe the subjects which such candidates shall be examined upon, and fix the standards of proficiency in such subjects required for granting such certificates, respectively.

8. All engineers now in charge of a steam plant, and who have been in such charge for two years or more, shall be granted a certificate without examination for their plant, or any other plant of the same capacity, by paying the regular fees.

8a. In any steam plant where at the passing of this Act two or more engineers are employed, the assistant or assistants shall be granted a certificate one grade lower than the engineer in charge, according to the provisions of this Act.

9. Any person claiming to be qualified to perform the duties of a steam engineer may apply to the examining board for a certificate, who shall examine the applicant and the proofs that he produces in support of his claim, and if upon full consideration they are satisfied with his character, habits of life, knowledge and experience in the duties of an engineer are all such as to authorize the belief that the applicant is a suitable and safe person to be entrusted with the powers and duties of such a station, they shall, upon payment of such fees as may be fixed by the said association, grant him a certificate for the class he is entitled to after the said examination, for one year under the hand and seal of the board of examiners, and the said certificate, subject to the above conditions, shall be renewed yearly.

9a. The directors may from time to time make by-laws not contrary to the provisions of this Act, to regulate and provide for the holding of the annual meeting of the association, the appointment of a secretary, a treasurer, and other officers; the duties of such officers, the procedure at annual meetings, and generally to regulate the affairs of the association; but every such by-law and every repeal, amendment, or re-enactment thereof, unless in the meantime confirmed at a general meeting of the company, and in default of confirmation thereat, shall at and from that time only cease to have force, and in that case no new by-law to the same or like effect shall have any force until confirmed at a general meeting of the company.

10. The certificate of any engineer may be revoked by the examining board upon proof of negligence, unskillfulness or drunkenness, or upon the finding of a coroner's inquest.

11. The board may cancel any such certificate when it is shown to their satisfaction that the holder—

(a) Is habitually intemperate or addicted to the use of drugs;

(b) Has become mentally unsound or physically incapable;

(c) Has proved incompetent or grossly negligent in the discharge of his duties;

(d) Has obtained his certificate through misrepresentation or fraud;

(e) Has transferred his certificate.

12. In no case shall a cancelled certificate be renewed until it be shown to the satisfaction of the board that the disability for which it was cancelled no longer exists.

13. Any person wishing to obtain such a certificate shall apply to the board of examiners for an application form, which he shall fill in, giving all the information therein required, with copies of such testimonials as shall be required, and shall return the application form to the board of examiners, with the required fee, when he shall be notified of the time and place where the examination shall be conducted.

14. It shall be unlawful for any person to serve as an engineer where steam is used at a pressure about or above seventy-five pounds who is not licensed by the board of examiners, and anyone so offending shall incur a penalty of not less than $10, nor more than $50.

15. The duties of the examining board shall be to examine all applicants for certificates of qualification as an engineer, and any member of the board of examiners may conduct examination of a candidate, but must be passed upon by the chief examiner and one of his assistants before the certificate is granted.

16. The certificates issued by the board of examiners shall be first, second and third class.

17. Candidates shall be examined upon a set of questions prepared from time to time by the board, and shall answer correctly at least sixty (60) per cent. of the questions presented.

18. In the event of the candidate failing in his examination ninety days shall elapse before he shall become eligible for re-examination.

Manitoba Association of Steam Engineers' Certificate.

.... Class.

This is to certify that .... is entitled under "The Engineers' Steam Act" to operate and have charge of a steam plant of not exceeding .... in the Province of Manitoba during the year 19.., unless his certificate is sooner revoked, cancelled or suspended.

Dated at Winnipeg this ..... day of ....., 19...

____

Chairman of Board of Directors.

20. Every applicant for a certificate or candidate for examination shall obtain one or more testimonials, signed in all by at least two reputable persons, stating that the applicant or candidate is temperate in his habits and of good character, but the board may demand such other testimony as to the character of the applicant or candidate as it may deem necessary.

21. Every person holding a certificate under this Act shall expose it in some conspicuous place in the engine or boiler room of which he is in charge, and in default shall be liable upon summary conviction to a penalty of not less than $5 nor more than $20. If such person is employed in charge of a portable engine or boiler he shall produce his certificate for inspection on being required to do so by any boiler inspector or any members of the board of examiners, and the absence of such a certificate or its non-production on demand shall be prima facie evidence that the person operating the engine or boiler has no certificate.

22. This Act does not apply to traction or thresher engines used for farm service only.

23. This Act does not apply to boilers, carrying under seventy-five (75) pounds pressure, used for heating water for domestic purposes or generating steam solely for heating buildings, or to railway locomotive or steamboat boilers, but shall apply to all other steam boilers.

24. Any person in charge of a plant of two hundred (200) boiler horse-power or over shall be required to hold a first-class certificate.

25. Any person in charge of a plant from fifty (50) to two hundred (200) boiler horse-power shall be required to hold at least second-class certificate.

26. Any person in charge of a plant up to fifty (50) boiler horse-power shall be required to hold at least third-class certificate.

27. The fees payable under this Act shall be paid to "The Manitoba Association of Stationary Engineers."

28. Any person guilty of a breach of the provisions of this Act, for which no provision is herein made, shall, on summary conviction thereof, be liable to a penalty not exceeding fifty ($50) dollars.

29. The fees payable for certificates of examination, and renewals thereof, shall be as follows:

First-class certificates, for examination $6, for renewal $3; second-class certificate, for examination $4, for renewal $2; third-class certificates, for examination $3, for renewal $1.

30. This Act shall come into force on the proclamation of the Lieutenant-Governor-in-Council.

LARGE POWER PLANT.

Some time within the next twelve months one of the largest electric power plants in British Columbia, that of the Western Canada Power Co., Ltd., now being erected on the Stave river about thirty-five miles east of New Westminster, will be placed in operation. This plant is being installed at a cost of $2,500,000, and when completed will be capable of supplying 50,000 horse power. The whole country for a radius of 175 miles around the plant may be supplied with light and power, and electric lines built throughout that section of the province.

The undertaking is one of the most extensive in Western Canada. At present a gang of about 235 men are employed on the erection of a dam across the river and the building of a power plant, while 100 more are working on the construction of a railway line from the C. P. R. main line at Ruskin to the site of the plant. During the next few months this force will be augmented by contractors engaged in erecting transmission lines throughout the lower Fraser valley, sub-power stations, and other necessary features of the establishment of a plant of this nature.

At the outset the intake dam across the Stave river for this power plant will be thirty-five feet in height and only two units of 13,000 horse power each will be installed. This will be doubled as the demand for power increases, the height of the dam being increased to sixty feet to give the necessary head of water. Further down the river, about three miles from its mouth, at the canyon the whole plant may be duplicated and another 50,000 horse power manufactured. The company has secured the water rights at this point to provide for this contingency.

R. F. Hayward, general manager of the Western Canada Power Co., and chief engineer, expects to have the first unit of the plant installed and ready to supply power about April 1st, 1911, and the second unit by July 1st. Transmission power lines will be put up at once. The company also propose to construct and operate electric car lines through the province although their plans in this connection are not yet matured.

Death recently claimed Dr. Kennedy Johnson, of Toronto, chief government inspector of electric meters.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. III SEPTEMBER, 1910 No. 9

ENGINEERS' CERTIFICATES

A correspondent asks if it would not be possible to have uniform laws governing engineers' certificates in the various provinces of Canada. Now that uniform boiler laws have been compiled, it should be an easy matter for the various provincial representatives to agree to uniform engineers' laws.

Until recently a holder of an Ontario engineers' certificate could secure a provisional certificate in the western provinces. To reciprocate, the Ontario Government amended the Ontario law to provide for the granting of provisional certificates good for one year. The amendment is as follows:

Every engineer "who has a certificate from any other province of the Dominion shall be granted a provisional certificate, such certificate to be good for one year."

And who applies to the Board shall, upon furnishing such evidence of good character and sobriety as the Board may require and upon payment of the prescribed fee be entitled to receive a certificate of qualification from the Board. (The words in quotation marks is an amendment added this year.)

Alberta has now refused to recognize an Ontario certificate, so that an Ontario stationary engineer who moves to Alberta must journey first to Edmonton and write, at once, the examination prescribed for engineers in that province. This is very harsh treatment and seems to us, in view of the amendment added by the Ontario Government a retrograde step, which may result in cancelling the privilege of an Ontario provisional certificate as far as Alberta is concerned.

A boiler is a boiler whether in Nova Scotia, British Columbia or any of the intervening provinces. Alberta has shown herself among the progressive provinces in making adequate boiler laws. It is, therefore, a question for the engineers of Canada to discuss and bring before the various provincial governments, where it will receive the attention due such important matters. With uniform laws, an engineer will be given the freedom of the Dominion for at least one year. We believe that the province that rears the "keep out" sign will be the one to suffer and therefore suggest that an understanding be arrived at between the governments whereby an engineer will receive fair treatment when entering another province to earn his livelihood.

It seems to us that unless this is done, the public, including engineers, will be impressed with the idea that the provinces are levying a tax on engineers, making them pay for the right to work instead of using the laws to protect life and property. No other skilled workman is taxed in this manner. The engineer is examined to determine whether or not he is capable of controlling a steam plant and to make him pay twice if he chooses to change his abode or secure employment in another province is manifestly unfair to say the least. The laws are for the protection of the community and the community should "pay the piper."

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CANADIAN NATIONAL EXHIBITION

The annual Canadian National Exhibition, Toronto, has closed after another successful year. The attendance was larger than in any previous year and the exhibits of power equipment and supplies covered a broad field.

The Machinery Hall was long ago inadequate for the exhibition of machinery and it is to be hoped that before the exhibition of 1911, the new hall will be erected where greater space can be devoted to the exhibition of heavy machinery. A well equipped building would enable the manufacturers of large power machinery to display their apparatus and thus attract to the exhibition the prominent consulting and stationary engineers, who are interested in the large power development schemes which are under consideration or in course of erection in Canada to-day.

◆

SAFETY OF BOILERS.

It is a well known fact that there are fads and fashions in matters mechanical as well as in spring millinery or the latest cut of clothes. The most recent fad affecting the steam-generating end of power-plant equipment is to try and see how much steam can be generated per square foot of water-heating surface, and some engineers have apparently gone "daffy" on the subject, says Power. It seems that since the results of certain experiments made at St. Louis to prove or disprove Prof. John Perry's theory regarding the transmission of heat in boiler practice have been published, many engineers have been trying to prove to their own satisfaction that Professor Perry was in the bounds of reason when he stated that boilers should be made to do ten and possibly twenty times their usual rate.

High rate of heat transmission in boiler operation is by no means a new thing, although engineers are doubtless learning more every day about the laws and conditions governing transmission of heat.

The old two-flue boiler, which is now practically discarded, could deliver a boiler horsepower on one and one-half to two square feet of water heating surface without the slightest difficulty; in fact, the available capacity of this type of boiler was such an uncertain quantity that the only satisfactory method to pursue in replacing them with other types was to measure the actual evaporation obtained and use this as a guide in selecting the proper capacity for the new boilers. Comparison on a heating surface basis between the two-flue boiler and other types was likely to lead to most embarrassing results for the engineer responsible for such changes. The high evaporative performance of the two-flue boiler was, however, not obtained by uniformly increasing the evaporation over all the heating surface, but by extending the area of direct heating surface so as to include all of the heating surface of the boiler, for the combustion of the fuel in this type could be completed in the flues, and it was sometimes completed in the stack, if forced enough, all of which did not contribute to high efficiency, but did tremendously increase the capacity.

To make modern types of boiler do many times the work that is ordinarily expected of them, and do it with safety, it will be found necessary to have the additional work done by the heating surface not directly exposed to the fire, just as in the case of the two-flue boiler. Anyone conversant with customary boiler operation of to-day will not believe that the direct-heating surface of a boiler, if made of the usual materials, can possibly transmit ten times the heat that it is usually transmitting at present and still retain its physical characteristics.

Boiler-insurance companies have frowned on the various attachments for furnaces and boilers that have been brought out from time to time with promises to double capacities, and experience has taught that many such devices are detrimental to safety and seriously reduce the life of boilers on which they are used. With the agitation for, and the actual enactment of laws governing, the safe construction and operation of steam boilers, there will come a time when the maximum capacity that is allowed to be taken from a given amount of heating surface will be limited just as the steam pressure allowed is limited to-day. Overworking a boiler as regards the quantity of steam generated is just as dangerous as overpressure, and possibly more so, because of the insiduous manner in which defects rendering a boiler unsafe are produced by this means. Careful bookkeeping will probably show that with the possible exception of plants having a high peak load lasting for comparatively short periods each day, it is not economy to force boilers much beyond the usual rates that are obtained now. There are other items beside interest on the investment and operating charges to be considered, and reasonable safety of operation is one of these that must be given due weight.

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THE TECHNICAL PRESS AND TECHNICAL EDUCATION.

At the present time, when the matter of technical education is one of the subjects uppermost in the minds of many, it seems an excellent opportunity to draw attention to the wonderful assistance the technical press has afforded technical education in bringing it to its present developed state.

The commission appointed by the Government has been looking into the educational matter, and on their trip so far through the Maritime Provinces, have accumulated much information, reports of which appear in the daily press. The Power House has endeavored to keep abreast of this want for further knowledge along these lines, as is instanced by the articles given for the instruction of Stationary Engineers.

Coming to the point of relationship between technical education and the technical press, a very little consideration will show that the latter has been probably the most potent factor in the agitation that is being felt all over the world—for more complete education for the working man, along the lines of his daily work, rather than going to the opposite extreme of educating with the professional idea in view as has been customary till quite recently.

The technical paper in its present form is a comparatively recent innovation. Its scope is very wide, reaching representative men in every trade. As most of the articles given are not gotten up on the spur of the moment, as with the daily paper, the element of error liable to enter is eliminated to a great extent, with the result that the technical paper has gained a reputation for veracity and reliability, built up largely by the fact that most of the articles are written by experts in their line. Thus, a power has been created. Information obtained as it has been, at regular intervals, has created a desire for more complete knowledge. This is stimulated by the appearance from time to time of articles containing more than the usual amount of mathematical theory, developed to deduce some practical result. The mechanic, reading this, feels his lack of education along this line, and out goes the cry for assistance—for lessons in fundamental engineering. Some papers have attempted to meet this demand themselves, with varying degrees of success, for the majority of papers have new subscribers adding to their number constantly, so that anything like consecutive work is difficult to obtain. Still further have these attempts stimulated the desire. This is witnessed in the United States, the Mecca for technical papers, where the agitation for more technical education has been very strong, resulting in the foundation of many such schools—the Cleveland school affording an example.

From this it can be seen that the technical press has been creating this desire—unwittingly to a large extent—and this desire fortunately has taken, and is taking, action, as witnessed by the constant agitation for it in the daily press.

◆

CALLING FOR TENDERS.

The attention of The Power House has been called to the shortness of time allowed in calling for tenders, a week to ten days and often less being allowed for important equipments. For instance, if a water power outfit is required, a week is allowed. The estimating departments of plants where these outfits are manufactured are busy and cannot give the time the tender would otherwise receive. To be on the safe side, the price is perhaps higher than it would have been, and the design is not as efficient, because of lack of time and overwork of this department.

Special designs are required to suit the conditions under which they are to operate. There is a different head of water or the flow of water from the wheel is retarded or a great number of other things must be taken into consideration. The same thing applies to other power plant apparatus to suit certain conditions.

This state of affairs shows that engineers requiring power plant apparatus and calling for tenders, should give the builders reasonable time to deal with the tender. There is no doubt that the purchaser of the apparatus will be the one most benefited.

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MANITOBA'S LICENSE LAW.

In this issue is given the bill recently passed by the Legislative Assembly of Manitoba. A perusal of this should be of interest to stationary engineers generally.

It will be noted that by this bill has been incorporated "The Manitoba Association of Stationary Engineers," and through it all certificates are issued. An excellent feature of the bill is the graded certificates, which should be adopted by all the provinces of the Dominion.

New Jaw and Friction Clutch and "Ideal" Split Pulley

The Positive Clutch and Pulley Works, Limited, Toronto, Have Placed Several Improved Transmission Appliances on the Canadian Market.

THE combined jaw and friction clutch combines the advantage of a friction clutch, to gradually pick up the speed of a driven shaft or pulley, etc., under load, with the positive drive of a jaw clutch. The frictions are not obliged to carry the load, but are used only for the purpose of operating the jaws.

The engaging portions of the jaws narrow slightly to their outer ends and are provided with suitable clearance to eliminate all contact and permit freedom of movement during operation. The springs prevent the frictions and jaws from engaging and disengaging except by movement of the operating lever, but assist in each operation. The friction and jaws operate independently by means of the one lever.

All parts are interchangeable, enabling a coupling or a pulley clutch to be converted to the other, and each to be used on other sizes of shafting. Sleeves are provided with graphite lubrication, and are made to standard diameters to fit the standard bores of pulleys.

The frictions are made of fibre, which prevents them burning. The friction capacity need be only sufficient to pick up the speed of the unloaded shaft or pulley as the jaws when engaged will carry the load which is afterwards applied, up to their rated capacity.

Description of Clutch.

The power shaft is indicated at B, and the load shaft at A. Mounted on the shaft A is a hub C, formed with a flange to which the disk D is bolted. Projecting through a central aperture in the disk D is an annular jaw E. The disk D at its periphery is formed with annular flange, which incases part of the clutch mechanism. A ring F is fitted within this flange and keyed to it, for rotation, but free for longitudinal movement. The ring has openings at suitable points to receive fibre blocks G, which protrude from the opposite faces of the ring. Keyed to the shaft B is a member H, on which is fitted a sleeve I formed with a flange at its inner end. A series of bolts J are fitted between this flange and a ring at the opposite end of the sleeve. A ring K is mounted to slide on the sleeve I, and the bolts J pass there through, while coil springs on the bolts J bear against the ring K, tending to press the latter outward. The flange of sleeve I and ring K have annular bearing surfaces adapted to engage the blocks G at opposite sides. They are pressed into engagement by means of levers L fulcrumed to the ring at the end of the sleeve I, and links M fitted between the levers L and the ring K.

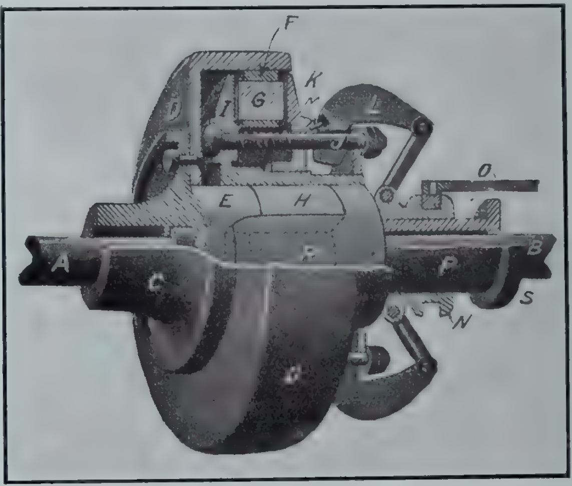


Fig. 1.—Section of Clutch Showing Essential Parts.

The levers L are connected by links to a sliding collar N, operated by a lever O fitted with a split collar in the usual manner. The collar N slides on a sleeve P, which at its inner end is provided with jaws R. These jaws are adapted to slide in recesses at opposite sides of the member H and the jaw E.

In operation to engage the clutch (see Fig. 1), by means of lever O, the collar N is moved forward along the sleeve P until it comes in contact with member R. This serves to process the flange I and ring K against the friction blocks G, by the toggle action of the levers and links connected to collar N, and to pick up the speed of the load shaft. When the load shaft is approximately brought up to speed the springs on the bolts J act through the levers and links to engage the jaws R with the recesses in member E and to disengage the frictions. When it is desired to disengage the clutch the reverse takes place. The frictional surfaces are first thrown into contact to relieve the jaws of the load and the springs then act in like manner to disengage the jaws and then the frictions. The frictional engagement is only momentary and the transfer of the load is almost instantaneous.

Ideal Split Pulley.

The split pulley manufactured by the Positive Clutch & Pulley Works, Limited, 11-13 Jarvis St., Toronto, has a wood rim, steel arms and malleable hub. A test of "Ideal" combination arm pulley 36" diam., 8" face was made in the mechanical laboratory of the S.P.S., by W. W. Gray. It transmitted 20 h.p. at 100 r.p.m., being the rated maximum power of an 8" double leather belt, based on a belt pull of 90 lbs. to the inch. The "Ideal" pulley consumed 1409 watts with sides uncovered and 1405 with sides covered. The windage was 4 watts or .005 h.p.; the weight and balance was

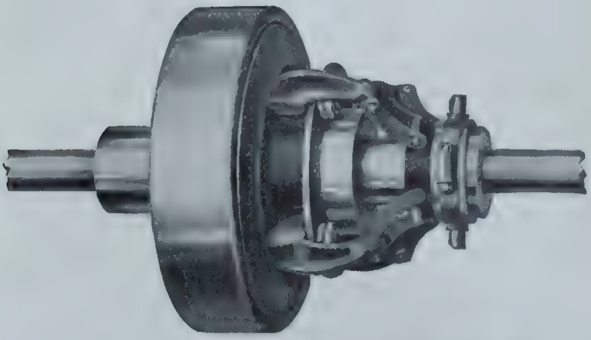


Fig. 2.—As it Appears in Service When Disengaged.

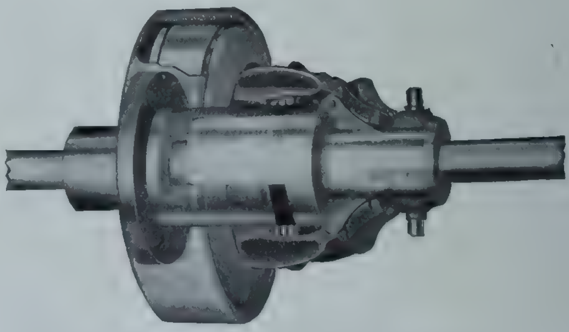


Fig. 3.—Showing the Position of the Jaw Parts and Friction.

27 watts or .036 h.p. The test was performed with shaft running at 400 r.p.m. at which speed the watts consumed to run shaft free of pulleys was 1378 watts.

Construction of Pulley.

The rim is made ol well-seasoned maple thoroughly kiln dried, each segment being nailed and glued to the adjoining segments. The arms are made of cold drawn seamless steel tubing, pressed into a ribbed form under enormous pressure.

The hub is made of malleable iron with a number of bosses ribbed together to impart strength and reamed out to receive the arms. The bolt holes are cored to fit the heads of the bolts, to prevent the bolts from turning. The bushings are made of cast iron and provided with sufficient bearing to prevent them slipping in the pulley or on the shaft. The bushings are interchangeable.

The arms are connected to the rim by means of saddle plates which are squeezed over the flattened ends of the arms rim, by means of stout pins driven through the saddles and arms and into the rim across the face of the pulley. The ends of the saddles are fastened to the interior of the rim.

The arms are connected to the hub under enormous pressure. They are forced inwardly on a taper, expanded outwardly at their inner ends and upset at the extreme outer ends of the hub bosses, thus making perfect connections without the use of rivets or screw threads.

Fig. 5 shows the parts of the "Ideal" combination split pulley, which is patented in all countries. In this figure, 1 illustrates the rim connection showing saddle and pins ; 2, the saddle plate ; 3, the arm before being forced into the hub ; 4, the hub connection showing the manner in which the arm is secured ; and 5, the bushings showing the large area of contact with the hub and the shaft.

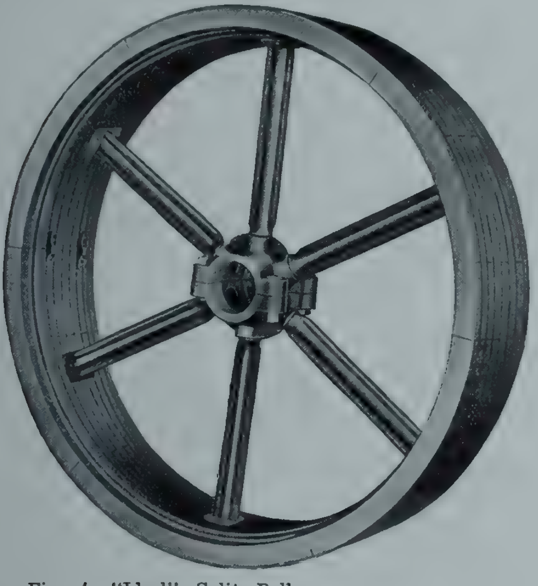


Fig. 4.—"Ideal" Split Pulley.

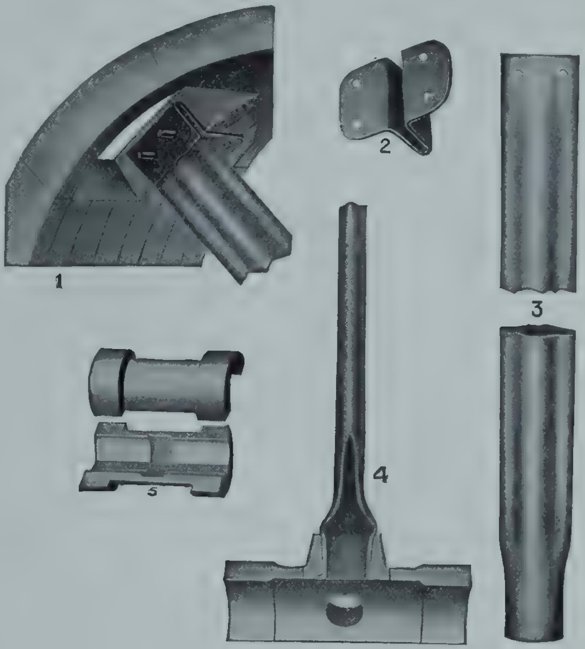


Fig. 5.—Parts of "Ideal" Split Pulley.

DART HAMMER MOLD.

Every engineer knows how necessary a soft metal hammer is when working about his engine, and with the Dart hammer mold he can easily make his own hammer at practically no cost and avoid the risk of using a make-shift. The Dart hammer mold is of iron, with skillet attached, and molds a 3-lb. hammer solidly to the handle. It is one of the handiest kind of tools to have in the engine room.

The opening in the mold for the handle is the size of a half-inch gas pipe, which is best to use, as it is light and places the weight of hammer where it does the most good, although solid handles may be used if desired. Split one end of the pipe and spread it a little; it gives the metal a better hold; then plug the pipe at the split end, so as to prevent metal from flowing through the handle; something solid is the best, as it saves doing again when a new head is molded on, for the same handle can be used repeatedly.

Place the handle in mold; clamping the mold on it with the little ring by tightening the set screw on top down snug.

Everything is now ready for the melting. When the metal is hot enough, slowly run it into the mold; do this by using the handle to tilt the mold. The little air-hole at side of run tells when the hammer is filled.

Do not let the mold proper be hotter than is absolutely necessary, as it will take longer for the hammer to cool. Under fair conditions a minute's time is all that is required.

This handy device is manufactured by the Dart Union Co., 93 Niagara Street, Toronto.

Dart Mould for 3lb. Soft Metal Hammer.

PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

SETTING CORLISS VALVES.

By W. Oelschlager.

Let it be supposed that the valves are to be set for the first time. By the aid of a plumb line set the wristplate, and rocker arm plumb, as per Fig. 1, and adjust the rod connecting the rocker arm to wristplate so that the hook or latch will drop onto the wristplate pin. Now mark the central position of the wristplate at A and B, Fig. 2.

Connect the eccentric rod to the rocker arm and then turn the eccentric on the shaft, to its full throw and mark the wristplate bracket, as at C, Fig. 3 in line with A on the wristplate. Now turn the eccentric to the opposite side and in a similar manner mark D opposite A, Fig. 4. With a pair of dividers measure the distances B C, and B D. If the distances BC and BD are not exactly equal, the eccentric rod must be lengthened or shortened as the case may be, and the operation of turning the eccentric on the shaft repeated, to prove the correctness of the marks.

To equalize the lap of the steam valves, place the wristplate in its central position and take off the back valve covers. A mark corresponding to the port opening will be found, and upon the end of the valve a mark representing the opening edge of the valve. These marks are usually placed there by the builders, and if missing, can readily be drawn with accuracy by removing the valve, and marking with a square, and scriber. In Fig. 5, E corresponds to the opening edge of the valve, and F to the edge of the steam port. If now the marks E and F are together, the edge of the steam port, and the working edge of the valve are line and line. Now set off FG equal to the required lap for the cylinder under consideration, and adjust the rods from the valve stem arms to the wristplate so that F and G are exactly together.

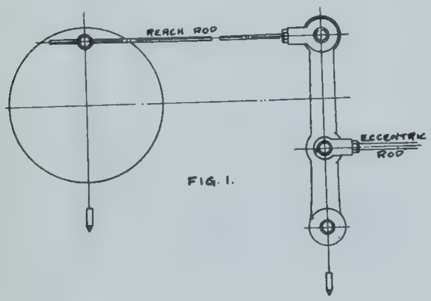
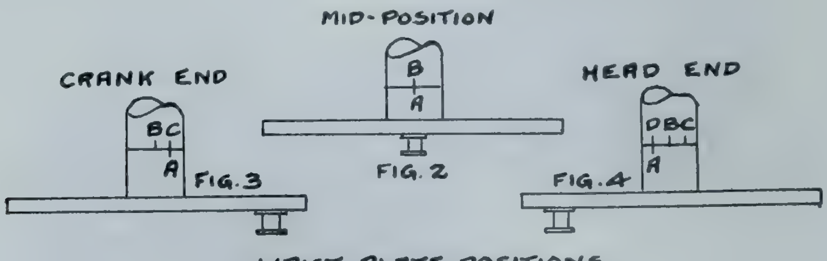


Fig. 1.—Setting Wrist Plate and Rocker Arm.



WRIST PLATE POSITIONS

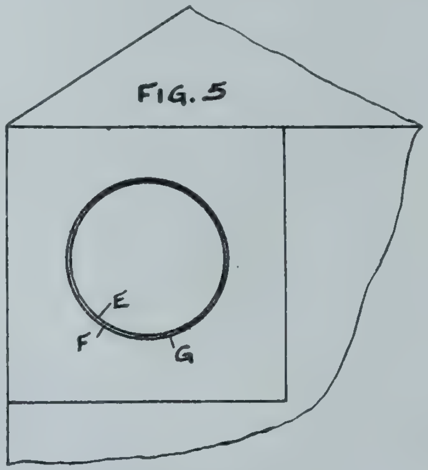


Fig. 5.—Setting Corliss Valve.

The dashpot rods may now be adjusted for the proper clearance between latch and latch block. When the wristplate is at its extreme throw, either way, the dashpot rods must be of the necessary length to insure the proper engagement between latch and latch block on the valve that is to admit steam. Move the wristplate so that the marks A and C shall be in line as in Fig. 3, giving the small amount of clearance at H, Fig. 6. Then move wristplate to opposite side so that A and D, Fig. 4, will line up, and adjust the rods in the same way.

Suppose the head and valve to be set first. Place the engine crank on the head end, dead centre, and, assuming the engine to be running over the eccentric must be turned on the shaft so that it will be 90 degrees plus the lap and lead of the valve (i.e., the angle of advance), ahead of the main crank. Tighten the set screws of the eccentric on the shaft, turn engine crank to opposite dead centre, and see that the lead of the valves are the same. If not the latter valve rod from wristplate to valve arm must be adjusted, which will make it necessary to readjust the dashpot rod for its proper clearance at H, Fig. 6. The exhaust valves must close when the piston is 2 inches from the end of its stroke. Turn the engine crank in the direction it is to run until the piston is 2 inches from the end of its stroke. Adjust the exhaust valve rod between wristplate, and valve arm until the working edge of the valve is line on line with edge of port. This is the exhaust closure. Now turn the engine over until the piston is 2 inches from opposite end when the other exhaust valve may be set in the same way.

All modern Corliss engine governors are provided with a safety stop to prevent the engine racing should the governor belt break. The safety should be shifted to allow the governor sleeve to drop to its lowest position. The wristplate must be rotated to its extreme throw, either way, and the safety cams fastened in order that the valves cannot pick up. Replace the governor sleeve on the safety stop, and adjust governor rods to the knock off cams, so that the valves will be released when the wristplate is in its extreme position. Now block up governor into its central position, turn the engine over in the direction it is to run until the head end valve is released, measure the part of the stroke the engine has moved from the dead centre, mark an equal distance on the other end from the crank dead centre. See if the crank end valve is released at this mark. If not the governor rod at this end must be readjusted for the required point of cut off.

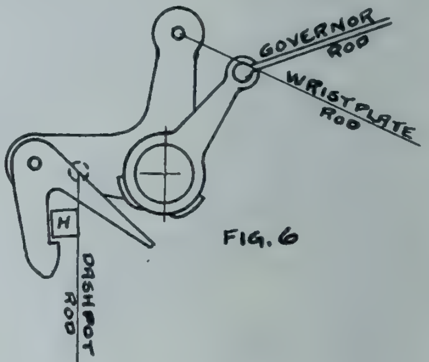


Fig. 6.—Setting Corliss Valves.

REPAIRING BOILER TUBES.

In the method of repairing boiler tubes, as done at the C.P.R. shops, West Toronto, there are several features of particular interest, which are worthy of note.

In old boilers, the tube ends sometimes become so rusted and corroded, that they must be removed, the ends cut off, and new ones welded on. As a large number of tubes require this treatment, several labor-saving devices have been improvised at the shops with the object of reducing expense, and at the same time improving the quality of the work.

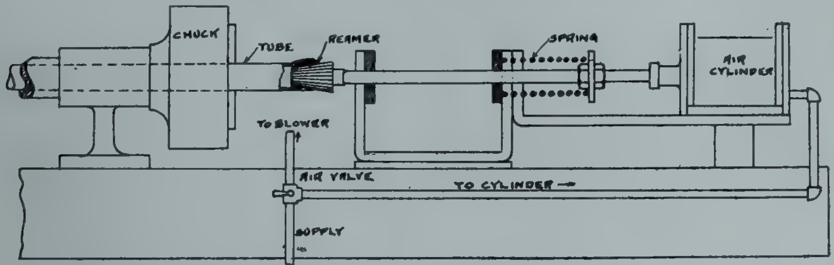


Fig. 1.—Repairing Boiler Tubes.

In many shops where new ends are welded on, it is quite customary to merely expand the end, introduce the new piece, and weld in that position, without tapering the ends to fit each other. This method, owing to the sharp ends coming on the flat of the other part of the tube, always leaves a seam around the tube, which tends to weaken it, often producing fracture. The C.P.R. always ream out the end of the tube with a taper reamer to a sharp edge at the end, and the new end is tapered down similarly to fit in.

In reaming out the ends, an improvised machine, Fig. 1, is used, unique in some respects. Essentially it is a lathe, the original idea being the feed, which consists of an air cylinder which shoves forward the reamer. Air is controlled by a two-way valve, which allows air out another passage as desired to a piece of rubber hose, used to blow the chips away. When the cylinder is released, the piston resumes its initial position again by the spring expanding. The make-shift construction of the lathe is interesting. It is formed of 2—7"x7" scantlings, on which are attached several wrought iron straps for securing the cylinder, etc. The reamer has a square shank which works in square holes in the cross-sectioned cross-pieces, which prevent it turning. The tubes are rapidly reamed by this method, a greater pressure being given than if fed by hand.

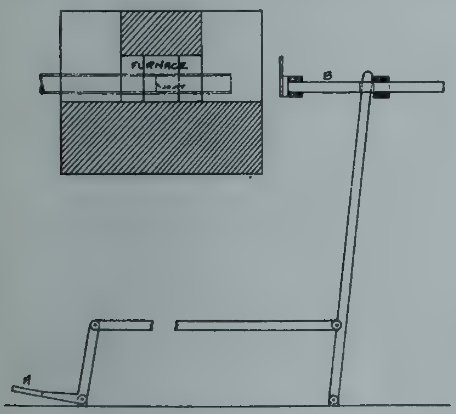


Fig. 2.—Repairing Boiler Tubes.

When ready to be welded, the two parts are placed together, and shoved into a furnace as in Fig. 2. The heat has a tendency to loosen the pieces which were lightly placed together, so, if removed when heated without precautions, they would probably part. A single expedient prevents this. When ready to remove, a tread A, some 4 or 5 feet back from the furnace, is pressed which slides bar B in its guides, the plate on the end striking the short piece of tube sharply, driving it further into the tube to be repaired, for the pieces are soft from the intense heat. This act in itself practically welds the pieces together, as well as doing what was originally intended, i.e. preventing the pieces falling apart before welding.

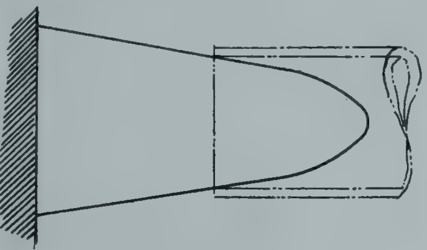


Fig. 3.—Repairing Boiler Tubes.

The welding is done under a quick-acting air hammer, the tube being slipped over a mandrel during the operation. The process insures a very nearly perfect joint, without mark, the size of the pipe being but slightly below the standard.

Before putting into the boiler the back end must be expanded slightly so as to fit the tube sheet better. Formerly, this was done as in Fig. 3, by first heating the end of the tube for about an inch, and driving the tube up on a tapered pin, by a couple of men swinging back and forth onto the pin, driving it further each swing till expanded the proper amount, a very slow job.

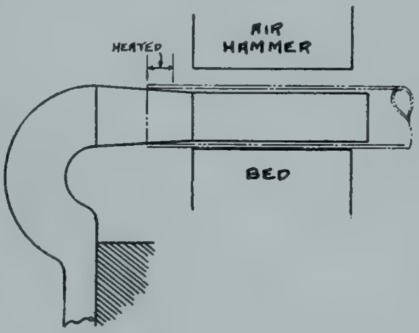


Fig. 4.—Repairing Boiler Tubes.

Fig. 4 shows the method used now for expanding the end. As before, the end is heated, but with the difference that it is now placed on a mandrel, tapered at one end, and under an air hammer. The oscillations set up in the pipe by the quick acting hammer striking the cold part, back from the heat, causes the end to swell, the operation being practically instantaneous, the blows being so rapid. The method is very much quicker and better than the old way, and the production is greatly increased.

LOW PRESSURE STEAM BOILERS.

The Fidelity & Casualty Co., 92 Liberty St., New York, furnish the following rules for operating low-pressure steam and hot water boilers.

1. On entering the boiler-room, ascertain if the valves between the boiler and water-column are open. Then blow down water-column, noting the return in the glass, and test the gauge-cocks, until absolutely sure of the water-level. This should be done at the beginning and end of each watch.

2. Open each door to boiler at least once a day and look carefully for leaks at every possible point, noting tube-ends, seams, and blow-off pipe in furnace. Examine carefully the fire-sheets for bulges, bags, or blisters. In the case of cast-iron boilers look out for cracks also.

3. Have all defects and leaks repaired without delay.

4. Safety valves are liable to stick on their seats; they should therefore, be raised carefully at frequent intervals, preferably once every day. Attach a small wire cable to safety valve lever, pass it over a pulley, and bring the end down to a convenient place for ready service in lifting the valve. See that the outlet to each and every safety valve is full size of valve opening. When washing out boiler, oil safety valve with cylinder oil.

5. When steam gauge indicates maximum load on safety valve approved in last inspection report, of your boiler inspectors, the safety valve should be blowing off freely. If it does not, ascertain at once why not.

6. Keep gauge cocks in good order and use them, as water glasses are very unreliable. Place tees or crosses at the bend of both pipes from boiler to water column; remove the plugs and clean these pipes when washing out boiler.

7. First, last and always, be careful that you have the proper amount of water in the boilers when in service. Don't fail in this. Don't permit the water to get low. Don't depend on the automatic water feeder. See to it yourself that the boiler gets the proper amount of water. Don't fill an empty boiler with water when there is a fire in the furnace or when the furnace walls are hot. Don't let any one else do this. Remember that water coming into contact with hot metal will crack the metal. Don't permit any person to draw water from the boiler when there is a fire under it. Your personal safety and the safety of the boiler requires strict observance of this rule.

8. In case of low water, cover the fire with wet ashes, or with green fuel if wet ashes are not available, and close the fire doors and ash-pit doors. Don't touch the safety valve. Don't turn on the feedwater under any circumstances. Let the steam outlets remain as they are until the boiler has been cooled off and examined to determine what damage has been done.

9. When connecting boilers, exercise great care. See that the pressure on the steam gauges agree before attempting to open the steam valves. Open the valves very slowly, and, if provided with small by-pass valves, use these before opening the large valves. Never connect boilers unless the steam pressures agree. Many explosions have been caused by neglect of these precautions.

10. Do not close the damper entirely when there is fire on the grates, as gas may collect and result in an explosion as destructive of property as a boiler explosion.

11. Provide a "V"-shaped brick pier or asbestos cover to protect the blow-off pipe from direct flame in furnace. Have this pipe extra heavy with malleable elbow. Open and close blow-off cock slowly to avoid water-hammer.

12. Keep the boiler dry on the outsile, as moisture will cause external corrosion.

13. Keep the brickwork tight so that cold air does not enter, as it will cause fuel losses. Fire lightly and frequently and endeavor by all means to save fuel for your employer. Endeavor to carry a uniform water-level when boiler is in service. Keep all appliances in good working order and as neat as possible.

14. In cleaning boilers, allow the fire to die out and the pressure to run down to zero. Admit air on top, take off the plates and use the hose thoroughly, then clean out all remaining scale. Examine all available parts and have defects repaired. If grease gets into the boiler, use sal soda to neutralize it, and see that the grease is kept out thereafter. It is dangerous to have grease in a boiler; dangerous to the boiler and dangerous to your personal safety.

15. In the case of hot-water heating boilers, the steam gauge shows the height of water in the system in pounds pressure. Before starting up, go to the expansion tank under the roof and see that the water is at the correct height in the tank. Then return to the boiler and make a mark with red paint on the steam gauge where the needle stands. Use this mark as a guide in filling boiler when necessary. The needle should always stand at this mark when the boiler is in service. Some boilers are provided with altitude gauges similar to steam gauges; if provided, their correctness should be tested in the same manner as the steam gauges by noting their readings when the water is at the correct height in the expansion tank. In hot-water systems no valves should be allowed in the pipes leading to or from the boiler and heating system, except radiator valves. If such valves are in have them removed, for if the valves are inadvertently closed an explosion will occur. An explosion of a hot-water heating boiler will also occur if it is not directly open to the atmosphere through the expansion-tank; it is your duty to trace out the pipe line from boiler to tank and know that it is open and safe. No safety valves are required on hot-water boilers open to the atmosphere through the expansion-tank. Insist on gauge-cocks and water glass being provided for the boiler as a safeguard.

16. Have all steam gauges tested by the inspector. The gauges should be placed on siphons and attached so that they may be readily taken down for test.

17. When the heating season is over, it is important that the boiler be properly cared for in order to prevent internal and external corrosion. Remove all the ashes from the furnace and combustion-chamber, and sweep clean all parts of the boiler in contact with the heat of the fire. Get some linseed oil and paint all surfaces exposed to the heat of the fire. Then let the water out and remove all scale, mud, and sediment. If the boiler is in a basement and dampness exists, put two to five pounds of sal soda in the boiler, close manheads, and fill up with water to ordinary level. If boiler is in a dry place, leave it open to the air after cleaning. In the case of steam heating boilers the radiators and pipes should be well drained and left empty of water. In the case of hot-water heating boilers, clean as above directed and lay up with the boiler and system filled with water, using sal soda to prevent internal corrosion. When the boiler is empty, go over the radiator valves and repack the glands. using well-oiled packing. Observance of this rule will prolong the life of the boiler and plant and reduce repair bills.

18. The inspection of a steam boiler is a matter of vital importance. When notified to prepare a boiler for internal inspection, proceed to cool down and clean the boiler as per instructions given in rule 14. Remove all scale, clean out the ashes and soot on the grates and in the combustion chambers, and sweep off the plates, heads and tubes, so that every part of the boiler may be examined and its exact condition determined. Have the boiler cold for the inspector when he arrives. Have the steam gauge ready for testing, water column connections open for inspection and everything in readiness to facilitate a thoroughgoing inspection of the boiler and all its connections. Careful compliance with this rule will protect your employer's interests and your own also.

HYDROSTATIC TEST.

By John L. Sheldon.

Sometime ago at a marine-engine works in England, a hydrostatic test was applied to a number of small pinnace-boilers. The intended working pressure was to be 150 pounds per square inch and the stipulated test pressure was 300 pounds. The hydraulic service at the works is under 1,500-lbs. pressure and the method of testing the boilers was to connect them to the hydraulic main, and by partially opening the valve, allow the required pressure to accumulate in the boiler. This plan usually worked all right but on this particular occasion the valve stuck and the pressure in the boiler rose to 1,500 pounds. The valve was finally closed and after relieving the pressure, we made a careful examination of the boiler without finding any leak or serious deformation. The remarkable part of it was that when the boiler was installed and steam was gotten up, it leaked all over and had to be consigned to the scrap heap.—Power.

Correspondence

Discussion on Previous Articles
Remuneration for Useful Ideas

SECOND USE OF OIL.

In reply to Ernest Ivie, I would say that it is necessary to know whether the steam supplied the engine is saturated or superheated before a definite answer can be given.—A Reader.

CYLINDER OIL CONSUMPTION.

A considerable difference of opinion exists amongst engineers as to whether the piston and valves ought to be lubricated, some maintaining that the moisture arising from the condensation of the steam provides sufficient lubrication. This may be the case with pressures as low as 70 or 80 lbs., which will cause condensation on the cylinder walls sufficient for lubrication purposes, but it has been found absolutely necessary to provide additional lubrication to cylinder when carrying higher pressures, such as 160 to 180 lbs., because of the higher temperature of the steam. Some engineers, no doubt, object to the use of internal lubrication on account of the injury it is likely to cause in the boilers when the oil is not of the highest grade, but when a high-grade oil is used sparingly no evil results should follow. It is not a good system to make any large decrease in the quantity of oil used, as it is extremely difficult to reduce to the proper quantity, and many cylinders have been cut up by trying too rapid a reduction. The pistons and valves should be regularly examined, and their condition will form a guide as to the quantity of oil to be used. Varying quantities are used by different engineers, from 1 gill per day to 1 pint per day. One engineer I heard of used 7 pints per day, with the result that he brought down his furnace crowns. It must be remembered that the best oils for internal lubrication have to go through an expensive process to insure their freedom from constituents of danger, having a low boiling point, so that it is impossible to get cylinder oil cheaply. In lake boats the danger of the oils to the boilers would be greater than on ocean vessels, as the density of the water in ocean boats is increased perceptibly. Thus the oil must have its specific gravity greatly increased before it will sink to the furnace crowns. The fact that mineral oil has a very solvent effect on copper and its alloys is also a very disturbing factor, as the copper particles might cause a strong galvanic action if carried through by the oil to the boiler, and should settle on the heating surfaces, and with galvanic action we have pitting, so that great care should be exercised in the quantity of oil used in cylinders.—John Shields.

WHAT'S THE MATTER WITH THE ENGINE?

The cards from Mr. Polson's engine seem to me to be very good. About the only thing that is the least wrong is that on one end (as it is not marked), I presume it is the head end, the exhaust valve closes a little early and the admission is also a little early.—Second Engineer.

Replying to Geo. Polson's question, the diagram shows too little lead, carrying the steam a little too far down the stroke before she cuts off and also indicates a leaky valve. Face up the valve and increase the lead, and the difficulty of keeping steam will disappear.—A. G. Roffey.

SAVING HEAT UNITS.

An exceedingly interesting paper was read at the C.A.S.E. convention at Berlin by H. L. Peiler. It was a little bit out of the ordinary, in that it treated of the saving of condensation for the sake of the heat units it contains, and the fact that it contains no scale-forming material, thus making it especially desirable for boiler feed. There is also the fact to be remembered that the more condensation we can return to the boilers the less make-up water we will have to pay for.

The paper is so interesting that if a lot of "us fellows" would get it printed in convenient form, so that we could read it and act on its suggestions, a considerable step would be taken towards the conservation of our national resources. We can easily get someone to talk engine design, boiler design, power plant design, etc., but to get the subject of saving of condensation put to us in the way in which it is done in the paper referred to,—well, it isn't done every day. In one plant that I know of, all the condensation goes to waste. As this is a heating plant, you can guess how great the waste is. It must amount to several thousand dollars per season. An extra line of small pipe and a vacuum pump would coin money for them. I understand a scheme is under consideration by which 75 per cent. of the condensation will be returned.

In another plant a press was heated by steam. A pressure of 60 lbs. is necessary to give the required temperature. The condensation was let out by a small Webster thermostatic trap or valve. When steam was turned into the cold press in the morning, of course, the trap was unable to pass the condensation, so the expansion element and valve were removed and the steam allowed to blow, unrestricted, through a hole about ¼-in. in diameter. To save the "condensation," which must have been nearly all steam after the press got hot, a 5x8x10-in. vacuum pump, big enough to take care of the condensation from 20,000 feet of radiation, was run all day during the summer. Of course, during the winter it ran to drain the heating system. The press would have less than 100 sq. ft. of radiation. A ½-in. Wright trap was installed, and the discharge connected to the feed water heater and the vacuum pump shut down. In the same plant a trap discharged to the sewer, while they had to use live steam for heating, the exhaust being insufficient. This trap was also connected to the feed water heater. In another plant the "old man" was describing the good qualities of a trap, an intermittent one, which he had recently installed. While we were looking at it the trap began to discharge—into the sewer. I talked traps and condensation to him for a while. We are remodelling the steam plant now, and that trap will be remodelled also.

In the same plant is a blast coil with about 3,100 ft. of 1-in. pipe, and supplied with live steam, while there is any amount of exhaust steam going to waste, and that might be condensed for boiler feed.

In another plant about 5,000 sq. ft. of radiation, which is operated at night, discharges condensation through Wright traps into the feed water heater. As it is out of the question to run the feed pump constantly, and as the condensation is at a temperature corresponding to a pressure of sometimes 100 lbs., you can guess that a great deal of water, and more heat, went to waste. A return trap was installed and now the water and heat are returned directly to the boilers.

Mr. Peiler advises covering the returns. If by returns is meant the pipe between the trap and the machine drained, then by all means cover it. The reason for this may not at first thought be apparent, but a second thought should convince anyone that it is just as necessary to cover the returns as the supply pipe. Take, for instance, a float-operated trap, such as the Wright, or the Anderson. As soon as water lifts the float the valve opens and water discharges. Even if there is a pocket in the pipe, the pressure will drive the water out toward the trap. A bucket or intermittent trap operates similarly in regard to leaving water in the pipe.

Thus we see there can be no water in the pipe if the trap is big enough, that is, no more than what condenses in the machine.

In regard to covering the pipe from the trap, well, that depends on the exhaust steam supply. If there is a surplus of exhaust steam, I would favor cooling it as much as possible, and shooting it into the feed water heater, where it will condense more steam. It is then a question of feed water, both as regards quality and cost. If there is a shortage of exhaust steam, then it is a question of heat units, and usually there can be no question about the advisability of covering the pipe. This applies to non-condensing plants in which there is an open exhaust steam feed water heater.—R. McLaren.

BOILER FEED PROBLEM.

In replying to the above question of R.'s in your July issue, it would not be advisable to raise the steam pressure, as steam at the higher pressure contained more water volume for volume than steam at the lower pressure.—A. G. Roffey.

VALVE SETTING FOR BEGINNERS.

Replying to J. B. G.'s question on the above, might state that in reading indicator cards there are four points that must be closely watched, viz., admission and cut off of steam and the opening and closing of the exhaust. Your diagram shows no lead on one end of cylinder and not enough on the other. Cut-off is about right, opening to exhaust correct and closing to exhaust late. The loop on the diagram may be due to a little water in the indicator or the indicator spring may be a little strong. Set the valve so that it admits steam at either end of the cylinder when the crank is on the dead centre; and to shut off the steam when the piston has traveled two-fifths of the stroke. Let the exhaust open just before the piston reaches the end of its stroke and close when it has traveled four-fifths of the stroke back again.—A. G. Roffey.

FEED WATER DIFFICULTY.

I have charge of a plant with six 6x16-ft. boilers, which are fed with river water through a heater, containing 256 2-in. tubes, 9 ft. long, the exhaust steam passing through, and the water, under boiler pressure, surrounding the tubes. The tubes were all gone with pitting, and were taken out and a new set fitted last winter. I had hopes of being able to save the new set, but they seem to be going the same way. Have tried zinc slabs with no benefit. Have used small quantities of lime, and put washing soda in through feed pump regularly. There is no sign of pitting in the boilers. I will be glad to know of any practicable way of overcoming this trouble.—Subscriber.

TROUBLE WITH WATER SUPPLY.

Your correspondent says he has a 7x8 triplex Gould pump, run by a 15 h.p. motor. The capacity of this pump is 180 gallons at 45 r.p.m., through a 6-in. main 1,200 feet long, and into a tank 75 feet above the ground, that is, 75 feet-head, or 32.48-pound pressure per square inch. If the fall of 25 feet is included, there is 100 feet-head, or a pressure against the pump of 43.31 pounds per square inch, and the velocity of 180 gallons per second in a 6-in. pipe is 200 feet. Trouble comes from the water running back through the pump valves. If a perfect, or as nearly so as possible, check was on the suction pipe, the tank would hold the water O.K., and if the relief is set at 50 pounds and the water runs out at 43.31 pounds, the relief valve is not in order. A pressure of 43.31 pounds will not lift 50 pounds if the 4-in. valve is closed. If the relief valve blows off there is more than 50-pound pressure behind it, and when the 4-in. valve is opened the pressure is off.—Interested.

HEATING PISTON ROD.

In your June issue Subscriber asks if any one has had an experience similar to this, in regard to the heating of a piston rod when the engine is running light. The writer has seen trouble almost identical with this on a moderate-sized triple-expansion engine. Whenever that engine was slowed down, if the oiler did not get round the middle platform and swab the rods, one of them (the I.P. usually) would warm up. The trouble was blamed on the fact that throttling the engine caused the steam to be slightly superheated, and therefore dryer than usual. The water which came into the cylinders with the steam while running full speed would be almost sufficient to lubricate the rods. It is well known among engineers that a h.p rod, which generally has a slight amount of water dripping from the gland very rarely heats up, and if it does it can be easily cooled by slackening the gland sufficiently to allow a little water to pass. On the other hand, an l.p. rod, which works in dryer steam, is no catch to cool out once it has got a red streak on it. As a probable remedy I would suggest to Subscriber to try a first-class semi-metallic packing on his rods. These packings are expensive, but if used in conjunction with common sense, need not be extravagant, as the writer has known the former to last for two years in a marine engine carrying 160 lbs. per sq. in., being once blown out during that time to cut the ends, which had become butted.—B. C. Subscriber.

LEAKY VALVES.

A. F. Moray's engine does not seem to be leaking much, though it would be easier to tell if Mr. Moray had given us the atmospheric line. It is developing 113.6 h.p., having an m.e.p. of 38.125 lbs. If the valves were set to cut off a little earlier on the head end, it might take a little less steam, as there is a difference of nearly 4 lbs. per sq. in. in the m.e.p. on each side of the piston.—Second Engineer.

FROST IN ENGINE ROOM.

I am troubled a great deal during the winter months with frost accumulating upon the walls and ceiling of the engine room. The building is a frame structure, the outer wall of which consists of one ply of boards, one ply of sheathing and a covering of galvanized iron; the inside is sealed with ordinary lumber. The frost collects on the ceiling and is apt to fall on the generators and engine and cause trouble.

We have arrived at the supposition that the strong draft under the boilers displaces the air in the engine and boiler rooms, causing a suction of cold air through all the crevices in the walls.

We thought it might be possible to overcome the trouble by instaling a cold-air duct from the outside to the ash pit. Opinions as to the advisability of this will be welcomed.—Charles Fenwick in Power.

In a paper recently read before the Western Society of Civil Engineers, the bridge engineer of the C. B. & Q. Railway advocated the substitution of concrete for wood in railroad trestles, the construction consisting of concrete piles, capped with reinforced concrete stringers, and overlaid with a floor of concrete slabs. When using machine-molded concrete piles, structures of this character have been build up to a length of 250 feet at a cost of from $20 to $25 per lineal foot.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

IMPROVED CYCLONE GRATE BAR.

Improvements have been made from time to time in the cyclone grate bar which have greatly increased its efficiency. Several of these improvements have been mentioned in The Power House, one being the changes on the bearing surface of the trunion.

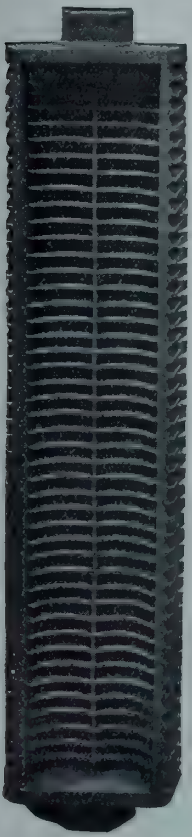


Fig. 1.

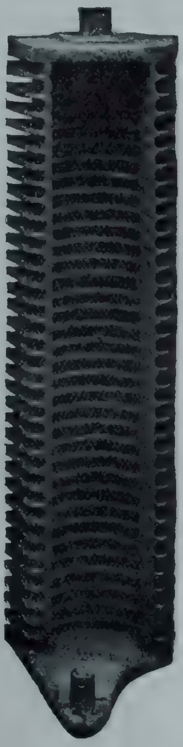


Fig. 2.

Instead of being round, a V-shaped piece has been removed from the trunion so that the bearing surface consists of two edges only. By this construction the grate bars are given an oscillating movement during the skaing operation, which effectively prevents any ashes or clinkers remaining on the bar section.

In the illustration, Fig. 2 shows the old bar and Fig. 1 the improved section. It will be noted in Fig. 1 that a reinforcement runs the length of the section. The manufacturers of the Cyclone grate bar claim that with this improvement, the life of the bar will be doubled.

Experience has shown that when the bar begins to deteriorate, the centre of the section burns away. To prevent the burning and thus lengthen the life of the bar, a reinforcement has been made along the centre line of the section. Besides making the bar less liable to burn it is made more rigid and will distribute the air very evenly.

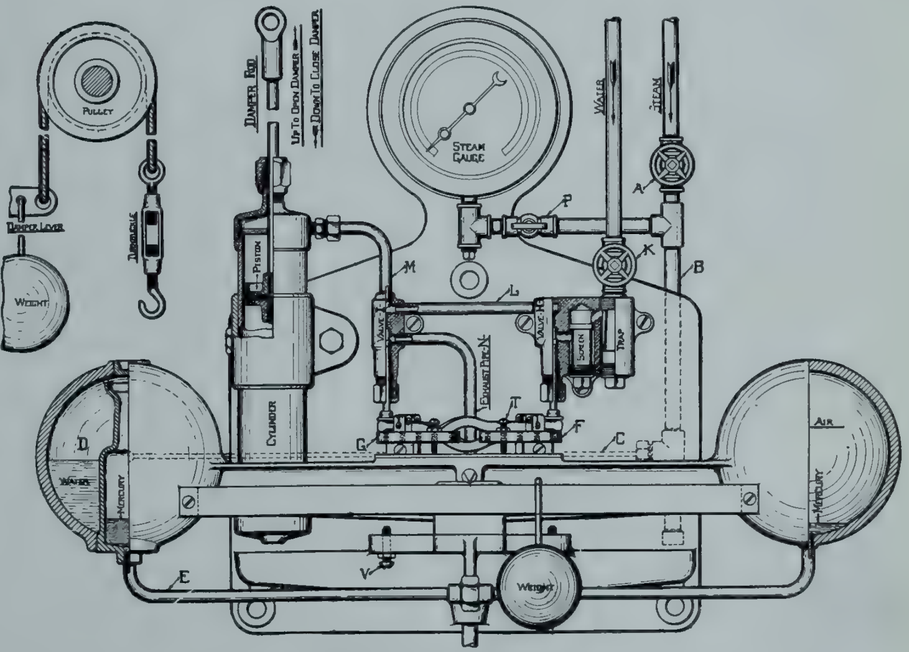
The Cyclone Grate Bar is manufactured by the Canadian Steam Boiler & Equipment Co., 186 Queen St. East, Toronto.

DAMPER REGULATOR.

The accompanying cut illustrates the "Diamond" Damper Regulator, which differs entirely in mechanical features from anything in this line which has been placed on the market up to the present time. The novel feature in the construction of this machine is the use of mercury as a balancing power to control the inlet and outlet water valves.

This mercury is used in connection with two hollow globes which are supported by a connecting arm, which rests on a knife edge in the centre. These hollow globes are also joined by a by-pass, through which the mercury moves back and forth as the steam pressure increases or decreases. The movement of the mercury from one globe to the other brings an increase as the case may be, which causes the connecting arm to tip. The tipping of this arm opens or closes the water valves which control the damper.

Another distinctive feature is the simple method of regulating the steam pressure point at which the damper may be closed, which provides for changes between day and night pressure of steam or for a change at any time desired. This is accomplished by simply sliding the weight to the right or left on the bar.



Diamond Damper Regulator.

An important point in construction is the ease of access to the water valves, in the event of its being desirable to remove these for regrinding. In all valves of this class, the valve stems are enclosed in chambers covered by caps, which have to be removed in order to take the valve stems out for regrinding, leaving the valve seat inaccessible.

The valves as shown in the "Diamond" Regulator are so constructed that the stems may be reground into the valve seats without the removal of the stem from the valve body, or the removal of any other part of the regulator.

As the cut will indicate, the regulator is connected to a water or air supply. This supply should have a pressure of at least 20 lbs. It is also connected with a steam line carrying boiler pressure, see A.B.P., A being the controlling valve of the regulator and P showing the connection with the steam gauge. (B) carries the steam to a flexible drawn copper tube (C), which connects with globe (D) on the left. Globe (D) is filled with water caused by the condensed steam. As this globe fills, it drives the air through the inner chamber as shown in the cut and through the by-pass (E), driving the mercury before it into the hollow globe on the right. As the pressure in both globes becomes equalized, the mercury naturally drops back into the by-pass, where it remains to be shifted from one side to the other according to the increase or decrease of the steam pressure. When the steam reaches the required pressure, the counter weight as shown on cut is placed on the scale in such position as to exactly balance the two hollow globes.

As the steam increases above the required pressure, the mercury is driven towards the hollow globe on the right, which increases the weight on this side and tips the arm. The tipping of the arm opens the inlet water valve (H) by means of a lever, connected at (F) with valve stem and extending across the knife edge rest and touching the balance arm by the use of an adjustable set screw (T). The water before reaching valve (H) passes through a trap or settling chamber and a screen. After passing valve (H), the water flows through (L) and (M) to the cylinder, driving the piston down, which closes the dampers.

As the steam pressure decreases, naturally the pressure in the globe (D) on the left also decreases and the compressed air in the hollow globe on the right assists in driving the mercury back to the left, causing the left end to become heavier. This movement of the mercury of course, tips the arm down to the left side and closes the inlet valve (H), which shuts off the water supply. At the same time, it opens the outlet valve (I), which allows the water to flow from the cylinder back through (M) into waste pipe (N), as the piston is drawn up by the weight of the damper as it opens.

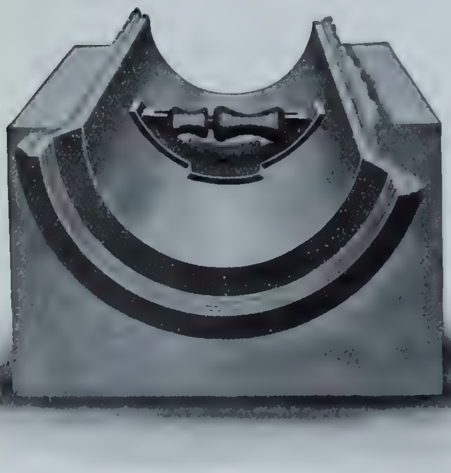
The Diamond Damper Regulator is manufactured by the Diamond Power Specialty Co., Detroit, Mich.

METHODS OF TRANSMITTING POWER.

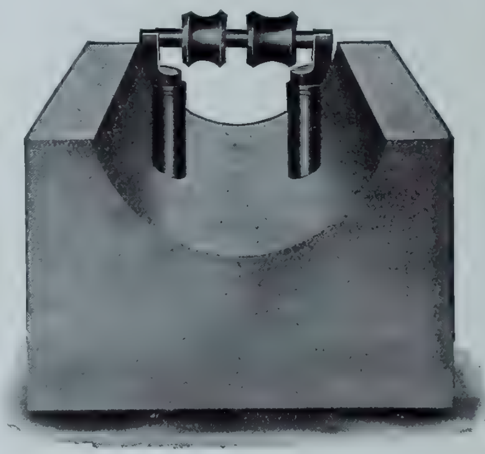
According to Prof. R. C. Carpenter, in his book on Heating and Ventilating Buildings, the loss of power in transmitting 100 h.p. 1000 feet is as follows :—

By Line Shafting	25 p.c. to 40 p.c.
By Electricity- line loss	2 p.c. to 5 p.c.
Transforming from mechanical to electrical and vice versa	20 p.c. to 30 p.c.
Total loss	22 p.c. to 35 p.c.
By Conveying Steam	
Naked Steam Pipe in Air	37 p.c. to 45 p.c.
Pipe covered with solid wood and earth	11 p.c. to 13 p.c.

Comparing these figures it will be seen that transmitting power can be more economically accomplished by conveying steam through properly insulated pipes than by either shafting or electricity. A test of 600 feet of 6 inch steam pipe insulated and protected by the Portland sectional conduit method shows even greater efficiency than Prof. Carpenter's figures. With steam at 83 lbs. pressure this line of pipe showed an efficiency of 88 7 p.c. as compared with uncovered pipe in free air. Noting that Prof. Carpenter's figures give the actual mechanical loss in transmitting steam through naked pipes as 37 p.c. to 45 p.c., the loss if the pipes were insulated by the Portland Sectional Conduit system would be from 4.2 to 5.1 p.c.



Details of Pipe Supports.



Details of Pipe Supports.

The centralization of steam generating plants and the resulting economies to be gained thereby have been largely made possible by the perfection of underground pipe insulating systems which afford a means of conduction with a very small loss of heat. Furthermore the economical utilization of exhaust steam delivered from a central power plant installation for heating purposes in a group of buildings can only be successfully achieved when the transmission pipes are so insulated as to prevent any material loss by radiation. The accompanying cuts show details of the system of pipe supports and covering as manufactured by the Portland Stone Ware Co., of Portland, Maine, and Boston, Mass.

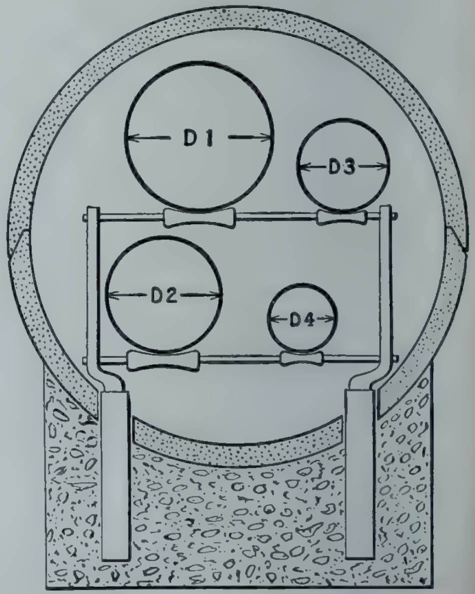
There are two methods of supporting the pipes, one entirely independent of the sectional covering, for large heavy pipe, or when the ground is not firm ; the other for smaller piping which can be supported by the conduit itself without damage. In the former method there is absolutely no danger of cracking the conduit should there be any movement vertically by settlement or horizontally by expansion and contraction.

The conduit itself is so thoroughly vitrified, salt glazed as to make it absolutely impervious to any water, acids or other injurious substances from the outside, while the innumerable air cells in the structure make it an excellent insulator itself.

The pipes may be covered with sectional insulation of any approved material or the conduit may be filled with loose insulating material.

The following tests conducted by Mr. George H. Barrus, Consulting Engineer, on 600 feet of six inch black iron pipe protected and insulated with Portland sectional conduit, show the high efficiency of insulation secured in this system.

In this particular instance it was possible to dispense with four independent steam generating plants and concentrate them all in one. This has shown a big economy in operation and furthermore the line of steam piping is designed with the view of future extension to any new buildings which may be erected. This will cause a very material saving in the initial cost of the heating systems of these buildings.



SECTION SHOWING 4 PIPE SUPPORT
D_1+D_2+8'' = DIAM. OF CONDUIT.

IMPROVED VERTICAL TURBO FANS.

The 50 h.p. seven stage vertical turbofan which is here illustrated is one of eight designed by the Kerr Turbine Co., Wellsville, N.Y., for supplying forced draft to the boilers of the torpedo boat destroyers Sterrett and Perkins.

These turbo-fans operate at a maximum steam pressure of 265 lbs. and noncondensing against 5 lbs. back pressure. The fans of the American Sirocco type are placed to take air from the outside through funnels on the deck and discharge it into the fire room through adjustable cone shaped casings. Two fans each operating at 1,655 r.p.m. deliver 4,000 cubic feet of free air per minute into each engine room maintaining within a pressure equivalent to four inches of water.

The installation arrangement is shown in the line diagram. The turbines are made right and left and are arranged in pairs, one pair delivering into each fire room. One unit is bolted directly onto vertical stanchion on each side of the boiler. It is evident from the diagram that the space restrictions are quite severe. Small diameter of the turbine is an important requirement and this was made possible without reducing the power below the desired limit, only by using seven rotors, each 12 inches in diameter. The use of many stages with light rotors of small diameter in those turbines also overcomes trouble from gyroscopic action better than using fewer rotors of larger diameter. Experience has shown that in marine work the gyroscopic action of large heavy turbine wheels running in a horizontal plane and with bearings close together subjects the bearings to heavy side pressure as the boat rocks.

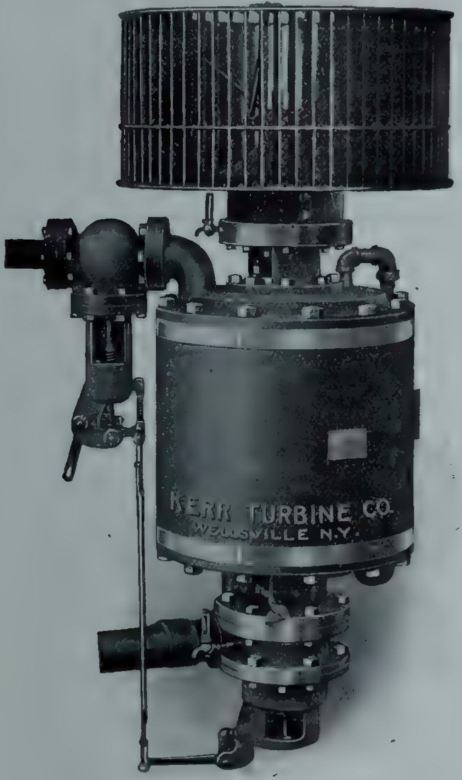


Fig. 1.—Improved Vertical Turbo Fan.

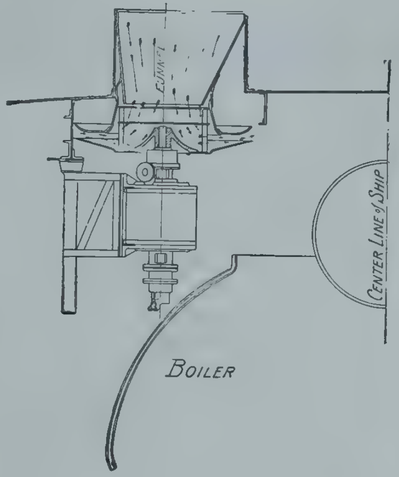


Fig. 2.—Improved Vertical Turbo Fan.

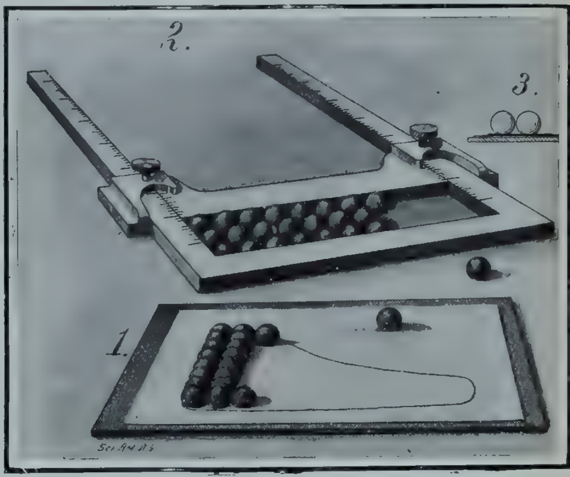
The effect of gyroscopic action is made negligible with the smaller wheels and is further minimized in these Kerr Turbines by the comparatively long distances between the bearings.

Kerr turbines have met with great favor for driving electric generators on shipboard and for driving marine auxiliaries because of their economy, compactness, reliability and the absence of oil from their exhaust. A turbine is always clean in appearance and seldom requires attention.

FREEMAN AREA FINDER.

The Freeman Area Finder, originally designed for the use of civil engineers to determine the area of irregular outlines has found a new field of usefulness among steam engineers in the reading of indicator cards. The device briefly described in principle consists of a flat steel plate that is magnitized and hence becomes a permanet magnet, and a number of small soft iron balls. The size of the plate depends upon the size of the drawing, but for ordinary work is about six inches in diameter, of circular form. To determine the area, the drawing is placed on top of the plate, and the outlines of the area is filled with the balls, which are flat on the under side to prevent rolling. The magnetized plate converts the balls into temporary magnets, which causes them to cling to the plate and to each other. After the plate is completely filled the balls are placed in a measuring frame and the number of square inches occupied is ascertained, this reduced to the scale of the drawing gives the area.

Applied to the reading of indicator cards of steam engines the principle is equally successful, it being only necessary to introduce another constant element in the constant used in working the card.



Freeman Area Finder.

The Freeman Area Finder gives the area of the card in square inches, and in order to obtain mean effective pressure, it is necessary to divide the area by the length of the card and multiply by the scale of the spring. These operations are done in the ordinary planimeter mechanically, and the result is m.e.p. when measured by the proper scale, but the same result can be obtained by the new device as with the old, expensive and and more tedious method.

If l is the length of the card, p the m.e.p. then the area $A = pl_1$ or $p = \frac{A}{l_1}$, but $P = ps$. Substituting the value of p, we have $p = \frac{A}{e_1}s$, which substituted in the old familiar formula $H.P. = \frac{Plan}{33000}$ we have $H.P. = \frac{Alans}{33000l_1}$ in which

A=area of card in square inches.
l =length of stroke.
a =area of piston.
n =number of revolutions.
s =scale of spring.
l_1 =length of card.

for any single engine all of above are constant except A, which is given by the new device.

The simplicity, and durability af this device enables it to be made and sold at an extremely low price. The inventor, Mr. Arthur C. Freeman, of Norfolk, Virginia, U.S.A., is now forming a company to place his device on the market.

ELECTRICITY FOR STATIONARY ENGINEERS

INDUCTION MOTOR TROUBLES.

Please answer the following questions:

1. In a three-phase induction motor, if the throw of the coils in the slots should be one and ten, how would the operation of the motor be affected if any other throw were taken, such as one and nine, or one and eleven?

2. I had a 100 h.p., 2,200 volt, 2-phase induction motor, 108 coils, 12 poles, which made altenately 4 and 5 coils per group per pole per phase. I wanted a 3-phase, 550 volt motor of this size, so decided to make one out of this one by reconnecting the coils. I connected 3 coils per group per pole per phase, which made the 12 poles, 36 groups and 36 coils per phase, and I found by connecting each phase in three multiple sets of 12 in series, I got practically a 500-volt connection per phase, so I connected the phases as shown in Fig. 1. With this connection the motor ran about 1-3 speed and pulled an enormous current. When connected as Fig. 2, i.e., reversing one phase, it ran all right, but pulled about 40 amperes running light. I thought this rather a heavy charging current, even for an old machine with ⅛ inch clearance. When connected up star, Fig. 3, it wouldn't go, but upon reversing a phase, as shown in Fig. 4, it ran all right with, of course, a smaller current than was taken by the delta connection shown in Fig. 2.

3. On belting the motor to a load, connected as Fig. 2, it worked all right up to about full load, but I don't think it would do the work it would do before the change on its speed dropped considerably, and it ran very hot, so we had to connect the load to the shaft again.—C. S. Howse.

1. It should not be affected providing the groups of coils forming the poles are wound uniformly, and that the same number of poles can be obtained by the change. Any difference in the number of poles will, of course, change the speed of the rotor.

2. In an induction motor a rotating magnetic field must be produced in the "stator" or stationary winding by means of a polyphase electric current. This rotating magnetic field cutting the rotor windings, causes an induced electromotive force in these windings, which causes current to flow, which in turn exerts the necessary torque and the rotor revolves. If one phase in the stator windings is reversed with respect to the others, it means that the magnetic field, due to it is traveling in the opposite direction to that of the other two phases, and therefore the electromotive force induced by it in the rotor windings will be bucking. Then having no rotating magnetic field there can be no turning effort by the rotor. With normal voltage applied and one phase reversed, i.e., the rotor at a standstill, the conditions are similar to those formed when a transformer has its secondaries short-circuited with normal voltage applied to its primaries, as an induction motor is really a form of transformer. This will explain the excessive heating under abnormal conditions, and will hold for either a delta or star connection. As to the 1-3 speed obtained with a reversed phase it looks as if the phases were unequal.

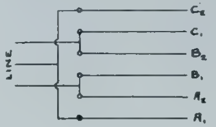


FIG 1.

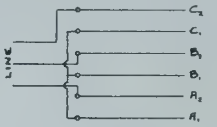


FIG. 3

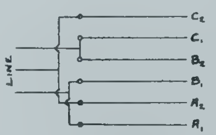


FIG 2.

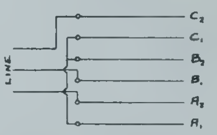


FIG. 4

The horse power delivered by a three-phase motor may be expressed as

$$\text{H.P.}=\frac{\sqrt{3}\times E\times I\times f\times e}{746}$$

while that delivered by a two-phase motor may be expressed as

$$\text{H.P.}=\frac{2\times E\times f\times e}{746}$$

Where

E=between line voltage.
I=line current.
f=power factor.
e=efficiency of motor.
and H.P.=horse power.

Considering an efficiency and power factor of 85 per cent. each, the current your original 2,200-volt motor would draw from the line in developing its rated horse power (100), would be, by converting the above equation,

$$I=\frac{74600}{2\times 2200\times .85\times .85}=23.5 \text{ amps. (approx.)}$$

To develop the same power, your new 500 volt motor would take

$$I=\frac{74600}{\sqrt{3}\times 500\times .85\times 85}=119 \text{ amps. (approx.)}$$

so that the no-load current of 40 amperes would not seem excessive, especially as I gather from your information that the new winding obtained was one of 500 volts and that your original demand called for 550 volts. Therefore I assume that the local power service is 550 volts, and that you tested a 500-volt winding with 550 volts, which is 10 per cent excess voltage.

3. This 10 per cent. excess voltage, and the fact that the terminals and end connections were carrying far more current than originally intended, will probably explain the high temperature under load with the proper connection. Conditions before and after the change are so different that it is not probable that you would get as much work from the motor in its new state as you did when it was operating under conditions for which it was designed.—C. L. Gulley.

THREE-PHASE INDUCTION MOTOR.

The remarkable performance of a three-phase, 220-volt induction motor of standard make is described in a recent issue of the Electrical Review and Western Electrician. The motor was placed in a mine at a point where the air was very damp, and water was constantly dripping. Because of the high temperatures prevailing at that spot the motor was not inclosed. The motor was geared to a mine pump. Last winter the mine was flooded, submerging the pump and the motor to a depth of two feet. As it was necessary to continue the operation of the pump, the motor was not shut down, and for two hours it ran without interruption, though completely submerged, until it had actually pumped itself clear of water. The motor suffered no damage, and was stopped only long enough to clean off the dirt and chips around the rotor, after which the bearings were oiled, and it was started again. Since then it has been running steadily for an average of twenty hours a day.

Design and Management of Electric Power Plants

First Article of a Series Dealing with the Whole Subject, Boiler and Engine Rooms, their Design, Management and Care, Illustrated.

By H. Brown.

When a municipal corporation or private company decide to install an electric power scheme in a district, there are two courses of procedure open to them.

First: They can call in the services of a consulting engineer, getting him to go over the ground and advise as to the most suitable system of electrical generation and distribution to adopt, and the approximate cost, suggest the site for the power house, sub-stations, etc., and to draw out the scheme in detail: finally getting out the specifications for all of the plant required.

The corporation then proceed to obtain the necessary loans and attend to any legal matters connected therewith, the consulting engineer assisting, if required. When the tenders are submitted he assists and advises the corporation in their choice and agreements when letting the contract.

He will then superintend the installation of the scheme and when the whole is completed and in running order his work is finished; and unless the corporation wish to retain him for any further developments, retires from the scene.

His remuneration for his services is generally based on a certain percentage of the capital outlay.

The second method is for the corporation to advertise for an electrical engineer who will not only be able to advise them and install their electric power scheme for them, but will also, after the work is completed, remain on as their electrical engineer, taking charge of the whole administration of this department, and being solely responsible for the successful working of it.

Unlike the consulting engineer who receives a percentage of the capital outlay as his remuneration, the latter gentleman receives a stated salary from the commencement, according to the terms upon which he is engaged.

The later course has many advantages over the former. Some being as follows: —The consulting engineer knowing that the future success of the scheme will not depend on himself, will hardly need to be so particular to keep the capital outlay at the lowest sum possible, especially as his remuneration is based on a percentage of that outlay. In the case of the engineer who is engaged by the corporation to carry the scheme on after its instalment, he knows that every dollar spent on the scheme will have to be met in sinking fund, interest, depreciation fund, maintenance, etc. It is, therefore, to his interests to keep the capital outlay as low as possible, compatible with absolute reliability in working. Further, the consulting engineer has to have an assistant to superintend the work during his absence. As he will probably have other work to attend to, and therefore cannot give his undivided attention to the scheme. In the other case the engineer being solely employed for the work will be in constant attendance and, growing up with the scheme, will have all the details, etc., at his fingers' ends, so that in future requirements he knows exactly how things stand; whereas the engineer appointed to follow in the steps of the consulting engineer, is largely ignorant of these things, and in fact, on many points may have views entirely contrary to those of the consulting engineer and which have been put into practice. This means that sooner or later he will seek to displace the consulting engineer's ideas with those of his own at a corresponding expense to the corporation.

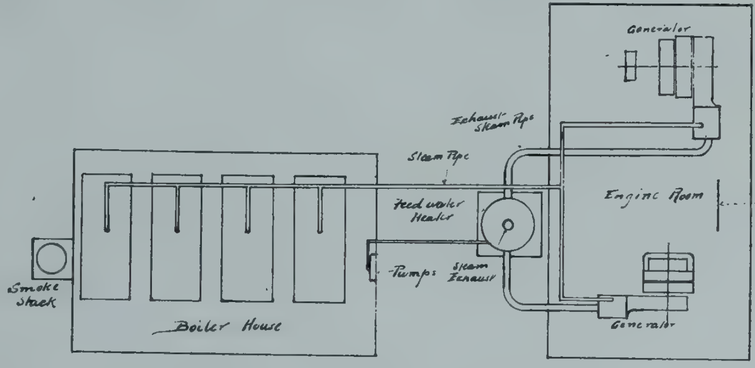


Fig. 1.—Plan of an Electric Power Plant Illustrates the Point Raised in Section 1 of Power House Design. The Design Fails in its Aim at Simplicity. (1) Because Every Item of Plant is Separately Housed, (2) Great Loss of Heat in Carrying Piping Through Open Air, (3) Great Amount of Pipe Work Necessary, (4) Great Amount of Building Necessity, (5) Tendency to Have Pipes Freeze up in Cold Weather.

The question of the type of engineer to undertake the work having been settled, and legal affairs having received their due consideration, it is necessary for the engineer to go over the district both on the map, and also in reality. The former will enable him to get a correct estimate of the area, dimensions, etc., of the district, the length and number of the principal streets, avenues, etc., and the locality of rivers, railways, collieries in their relation to one another.

By going over the district personally he will gain a good idea if its character, of its staple industries and the position of the various manufacturies. The residential parts will claim his attention as the expansion of these district may play an important part in the selection of the site for the power house; whilst if a system of street cars is likely to be installed, he will have to further take into account the supply of electricity for this purpose.

This latter item will require careful consideration by itself. The engineer, if he is also to act as the manager af the street car system will have to carefully note the amount of pedestrian traffic, and the hours at which it is most congested.

The location of athletic, fair, and other recreation grounds will have to be noted, and data obtained as to the popularity, etc., of these places.

The gradients will also require carefully noting, so that the feeding mains can be arranged to the best advantage.

The design of the power house and plant introduces many important propositions for the engineer to meet, and upon the way in which he does this will largely depend the successful operation of the station.

The most important points that should be considered can be enumerated as follows: 1. Simplicity of design. 2. Ease of making future additions. 3. Absolute immunity from breakdown. 4. Comfort and safety of employes. 5. Ease of repairs and examination of plant. 6. Fireproof qualities. 7. Economy of working.

All these various items seem to hang together, for it is almost impossible to fail in one without seriously diminishing the value of the others.

Simplicity of Design.

In the first place "Simplicity of design." On one occasion the writer visited a power station and found the roof supported by fancy brackets, far more suitable for a mansion than for their present position. These fancy designs cost far more than a plain bracket of equal strength, which would have done just as

(Continued on page 53.)

REFRIGERATION DEPARTMENT

CONDENSING WATER.*

By W. G. Walters.

Instead of supplying the steam boiler in establishments employed for mechanical refrigeration with the whole of their water direct from the main, I would suggest the advisability of making arrangements to draw the boiler water from the overflow of the ammonia condenser. Then if there is any deficiency, it can be made up from the main. This method of working would be beneficial in every respect, because in the first place the water in passing through the condenser will receive a certain amount of heat, which is distinctly an advantage, as boiler water is, or should be, heated before entering the boiler.

Again, if the whole or a part of the water required for the boilers is taken from the ammonia condenser overflow, the cost of condensing the ammonia is reduced to nothing, because the boilers have to be supplied with water, and the fact that the necessary supply has been previously used for condensing purposes, in no way increases the cost after the first cost of putting up the system of piping.

The effect of the use of a superabundance of condensing water will be a reduction of at least 30 to 40 lbs. per square inch in the condensing pressure and a corresponding saving in steam. If the temperature of the water supplied to the condenser is 55 degrees to 60 degrees Fahr., and the temperature of the overflow or outlet water is 85 degrees to 90 degrees Fahr., the quantity of water that will be required will be about 0.9 gallons per minute per 24-hour ton of ice.

If the temperature of the overflow were only 70 degrees to 75 degrees Fahr. (the inlet temperature being 55 degrees to 60 degrees Fahr.), the quantity of water that would be necessary would be about 2 gallons per minute per 24-hour ton of ice. This reduction of 15 degrees in the temperature of the overflow means a reduction of 30 to 40 lbs. in the condensing pressure, and if the ammonia leaves the condenser at the temperature of the inlet water a minimum condensing pressure and large saving of steam will result and a high efficiency will be obtained in the refrigerating machine.

The condensing pressure, when the machine is working, is always greater than the theoretical. This excess pressure is due alomst entirely to the confining of the highly heated gaseous ammonia in the more or less limited space of the coils of the condenser, and varies greatly according to circumstances. When running at a low suction pressure, say atmospheric pressure, the excess condensing pressure should not be over 30 to 40 lbs., but when running with a suction gauge pressure of 20 to 30 lbs. the excess condensing pressure will vary from 70 to 100 lbs. depending a great deal on the water supply and the medium through which the refrigerating is effected.

The reason why there is such a large variation in the excess pressure is obvious. With 28 to 30 lbs. suction gauge pressure the compressor is pumping a much greater weight of gas than it would pump if the gas were under a low pressure, and the condenser is crowded to a greater extent in the former than in the latter case.

It may be argued that if the compressor is forcing into the condenser a greater volume of gas, the condenser at the same time will be relieved of a greater amount of liquid ammonia, and that one will counterbalance the other. It is true, of course, that the weight of liquid ammonia passing the expansion valve will be the same as the weight of ammonia gas entering the condenser from the compressor, but as the volume of a given weight of the gas at condensing temperature and pressure is about 75 times greater than the volume of the same weight of liquid ammonia, it is easily seen that instead of pumping in 75 volumes of gas into the condenser we increase the amount 3 or 4 times or to 225 or 300 times the increased delivery from the condenser by means of the expansion valve. If it is only about 2 volumes it is insignificant in comparison with the increased receipt from the compressor and therefore the increase of excess condensing pressure is what might naturally be expected to accompany increased suction pressure.

REFRIGERATION MADE SIMPLE.

In the article by W. G. Walters in the July issue of The Power House, I should like to ask why it is that the discharged air from an air compressor has about the same temperature when compressed at 20 degrees below zero, as it has in mid-summer. This is the case, though the jacket cooling water is colder in winter than summer.—W. Duncombe.

TELEPHONES.

Few persons realize what an enormous amount of the precious metals and even precious stones, such as diamonds, are used in the manufacture of telephone apparatus. We have been informed by the Western Electric Co. that in a single year it uses upwards of a ton of platinum for this class of apparatus alone. As platinum costs 30 per cent. more than pure gold, it will be evident that this expensive metal would not be used so extensively unless results justified it.

A writer in the Electrical World recently pointed out that in sorting glow lamps according to wattage and candle power by the customary methods, there is a considerable expenditure of time involved, as each lamp has to be treated individually. He has, therefore, suggested using the relations between the pressure, candle power and specific consumption of any class of filament. He has worked out a graphical chart showing the relation between these quantities, and by observing these curves, it can readily be determined what pressure an approximate candle power can safely be assigned to any individual lamp in order that a certain specific consumption may be attained.

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* Fourth of a series of Refrigeration Articles by W. G. Walters.

Interesting Exhibits at the Toronto Exhibition

Some Noteworthy Exhibits of Power Apparatus and Equipment at the Thirty-second Annual Canadian National Exhibition, Toronto.

There was a large display of power equipment and supplies of interest to stationary engineers and manufacturers at the 32nd annual Canadian National Exhibition, Toronto. Among the many interesting ones are the following:

Butterworth Foundry Co., Ottawa—Improved Capital grates.

Alonzo W. Spooner, Port Hope—Babbit metals.

Positive Clutch & Pulley Works, Toronto—Demonstrating the combined jaw and friction clutch. The materials entering into the manufacture of this clutch have been carefully selected, and the parts are interchangeable.

Tallman Brass & Metal Co., Hamilton—Babbit metals.

International Harvester Co., Hamilton—Gas engines.

Canadian H. W. Johns-Manville Co., Toronto—Gaskets, packings, insulation for steam and refrigeration plants, etc.

S. F. Bowser & Co., Toronto—Bowser oil storage systems for power plants, garages and factories.

Canadian Producer & Gas Engine Co., Barrie—Gas engine, with a 50 h.p., 3-cylinder, with producer, in operation.

H. W. Petrie, Toronto—Comprehensive line of machine supplies and transmission, and a 65 h.p. Keighley gas engine, with producer, in operation.

N. J. Holden Co., Montreal—A comprehensive and interesting exhibit of railway supplies and air tools.

Ontario Wind Engine & Pump Co., Toronto—Samples of their latest improved gas and gasolene engines, etc.

Smart-Turner Machine Co., Hamilton—Power pumps in operation, 2-in. centrifugal pump, driven by 2-cyl. gas engine, vertical steam engine and centrifugal pump, belt-driven 1-in. centrifugal pump in operation, two sizes rotary gear pumps, triplex power pump, boiler feed pumps, outside-packed pot valve pumps, single and duplex.

Lunkenheimer Co., Toronto and Cincinnati—Neat display of Renewo valves and steam specialties. Ernest A. Wilkenson was in charge.

Garlock Packing Co., Hamilton—Garlock spiral and sheet packing, gaskets, etc. Howard G. Fletcher was in attendance.

Jones & Glassco, Montreal—Renold silent chain and Kenyon rope drives.

Dodge Mfg. Co., Toronto—Wood split and iron pulleys, rope drives, hangers, etc.

Canadian Steam Boiler & Equipment Co., Toronto—Improved Cyclone grate bars and vacuum valves.

Dominion Belt Co., Hamilton—Belts and belt dressings.

Jones & Moore, Toronto—A large display of motors.

D. K. McLaren, Montreal—Oak tanned leather belting and Phillips pressed steel pulleys.

Chapman Double Ball Bearing Co., Toronto—Display showing the application of ball bearings for shaft hangers, pulleys, bearings, etc.

Canada Metal Co., Toronto—Babbit metals.

Robertson & McGavin, Toronto—Power supplies, including J. D. McArthur belting, Komo steam trap, packings, flexible steel hose. They are also agents for the New York Belting & Packing Co.

Northern Electric & Manufacturing Co., Montreal—Demonstrating the operation of their fire alarm equipment, also the advantages and low cost of operation of their inter-phones.

Jas. Morrison Brass Mfg. Co., Toronto—Electric fixtures, injectors, and brass goods of all kinds.

Factory Products, Toronto — Noteworthy exhibit demonstrating principally the excellent lighting capacities of "Osram" lamps. This company is the Canadian agent of Stothert & Pitt, Bath, Eng., manufacturers of traveling cranes and hoisting machinery.

Park & Leith, Toronto—Agents for the British Aluminum Co. Display consisted of aluminum cables, and aluminum in various forms.

Gilson Mfg. Co., Guelph—Gas engines.

Crescent Oil Co., Hamilton—Lubricating oils and belt dressings.

Baines & Peckover, Toronto—Babbitt metal.

Other exhibitors were: Waterous Engine Works, Brantford; Goldie & McCulloch, Galt; F. W. Bird & Son, Hamilton; Berg Machinery Co., Toronto; Asbestos Mfg. Co., Montreal; John Gorde & Co., Toronto; Electrical Specialties, Toronto; Dunlop Tire & Rubber Goods Co., Toronto; Canada Rubber Co.; Canadian Westinghouse Co., Hamilton; Gutta Percha & Rubber Mfg. Co.

THE DIESEL OIL ENGINE.

On pages 38 and 39, is an article on "The Diesel Oil Engine," by Fred N. Moody. The cuts, unfortunately, were omitted, but will appear along with the article in the October issue.—Editor.

LARGE IRRIGATION WORK.

What is probably the largest piece of irrigation work undertaken at any one time is now being rapidly carried out by the C. P. R in Alberta.

According to a land official of the company, the block of land comprises nearly 3,000,000 acres of the original land grant of 25,000,000 acres, and lies in southern Alberta, bounded on the north by the Red Deer River and on the south by the Bow River. It is not a barren district, but efforts in the past at cultivation have not met with the desired success, and it became apparent that only by extensive irrigation could it be made profitably productive. Hence the undertaking.

The head-gates of the main canal are on the Bow River, some two miles east of Calgary. This canal is 17 miles in length and of a uniform width of 60 feet at the bottom and 120 at the water level line. It empties into a reservoir three miles long, one-half mile wide, and 40 feet deep.

The secondary canals, three in number and extending from this reservoir, are each 30 feet wide at the bottom and 60 feet at the water level line, and have a water depth of 8 feet. The combined length of these canals is about 150 miles. From these secondary distributing ditches are run in every direction, and the total length of these, together with the above mileage of the main and secondary canals, makes a total water channel of close to 1,000 miles. This is exclusive of the mileage of the lateral ditches when constructed.

Completed, the project will represent a total of nearly 3,000 miles of canal, which will have called for the excavation of 24,500,000 cubic yards of earth. The vast tract of 3,000,000 acres has a natural westerly inclination of 1,100 feet, which natural conditions will greatly facilitate the operating of the secondary canals and the ditches. The water supply from the Bow River is regarded by authorities as inexhaustible.

Regarding the probable cost of this extensive scheme, no figures have as yet been given out, and it is not likely that any will be given out until the whole project is completed.

Farmers will be expected to pay out of their own purses for the construction of lateral ditches that are to convey water from the larger distributing ditches to the farm lands. Each farmer taking water will be charged 50 cents a year per acre. The C. P. R. is confident that the returns will ultimately justify the enormous expenditures called for in the carrying out of this irrigation work.

Gas Plant in Operation at the Toronto Exhibition

H. W. Petrie, Limited, Toronto, had in Operation a Keighley Suction Gas Plant Complete with Engine, Dynamo, Switchboard.

One of the interesting exhibits of power equipment at the Canadian National Exhibition was that of the Gas Power department of H. W. Petrie, Limited, Toronto, in the east end of Machinery Hall. Here a Keighley suction gas producer was in operation supplying gas for a 65 horse-power Keighley engine.

In Fig. 1 is shown the plant, the photograph being taken while the machinery was in operation. The photograph gives a good idea of the layout of the exhibition plant.

The engine is shown in Fig. 2. It is a 65 horse-power, belt-connected, to a 230 volt 185 ampere generator, manufactured by the Lancashire Dynamo & Motor Co., Manchester, England.

The plant was used to supply light and power for a number of the exhibits. About half was used for each. The Petrie exhibit was brilliantly lighted, a large sign, "Economic Power," being in full view from any part of Machinery Hall. Current was also furnished for the outside sign lights on south side of building.

Suction Gas Plant.

The Keighley suction gas plant is shown in section in Fig. 3, and there are many mechanical features of interest in its design. The whole plant is automatic in operation.

The generator is designed especially for fuels available in Canada, and anthracite coal, coke, etc., may be burned. With some fuels, such as anthracite coal, the consumption amounts to only seven-eighths of a pound per horse-power hour during running hours.

Coal Supply Valve.

The coal supply valve (not shown in Fig. 3) is interesting in its operation. It lifts up, allowing the coal to fall in the centre of the generator. The sides of the hopper are at sufficient angle to deliver the coal as mentioned. It thus forms a complete cone, as may be seen in Fig. 3, feeding the coal down gradually.

Supply of Hydrogen.

An important feature is the manner in which hydrogen is supplied to the gas. Around the top of the generator is a reservoir containing water. From this the steam passes across and down the centre of the superheater pipe to the bottom of the generator.

It passes up through the fuel, where the air and steam unite. The oxygen of the air combines with the carbon of the fuel, forming carbon dioxide, CO_2. This is converted into CO in passing through the incandescent coal. The steam is broken up by the incandescent coal, leaving free H. There is also a little CO_2 present, but it is in small quantity.

Experiments have been made to decide the design of the grate and amount of steam necessary for fuels used in Canada, for upon the composition of the fuel depends the proportion of steam and air and design of grate.

The addition of steam and air produces a gas of greater heating value per unit volume. These assist also in keeping the grates cool and in keeping the temperature within the producer uniform.

The Scrubber.

The gas passes down the outside of the superheater, through the water at the bottom of the scrubber. This cools and cleans the gas. The water also acts as a seal, preventing the gas in the scrubber from escaping through purge pipe when plant is not in operation.

In the scrubber the gas passes up through a bed of coke, on which a spray of water is falling, as shown in Fig. 3. The gas then passes into the expansion

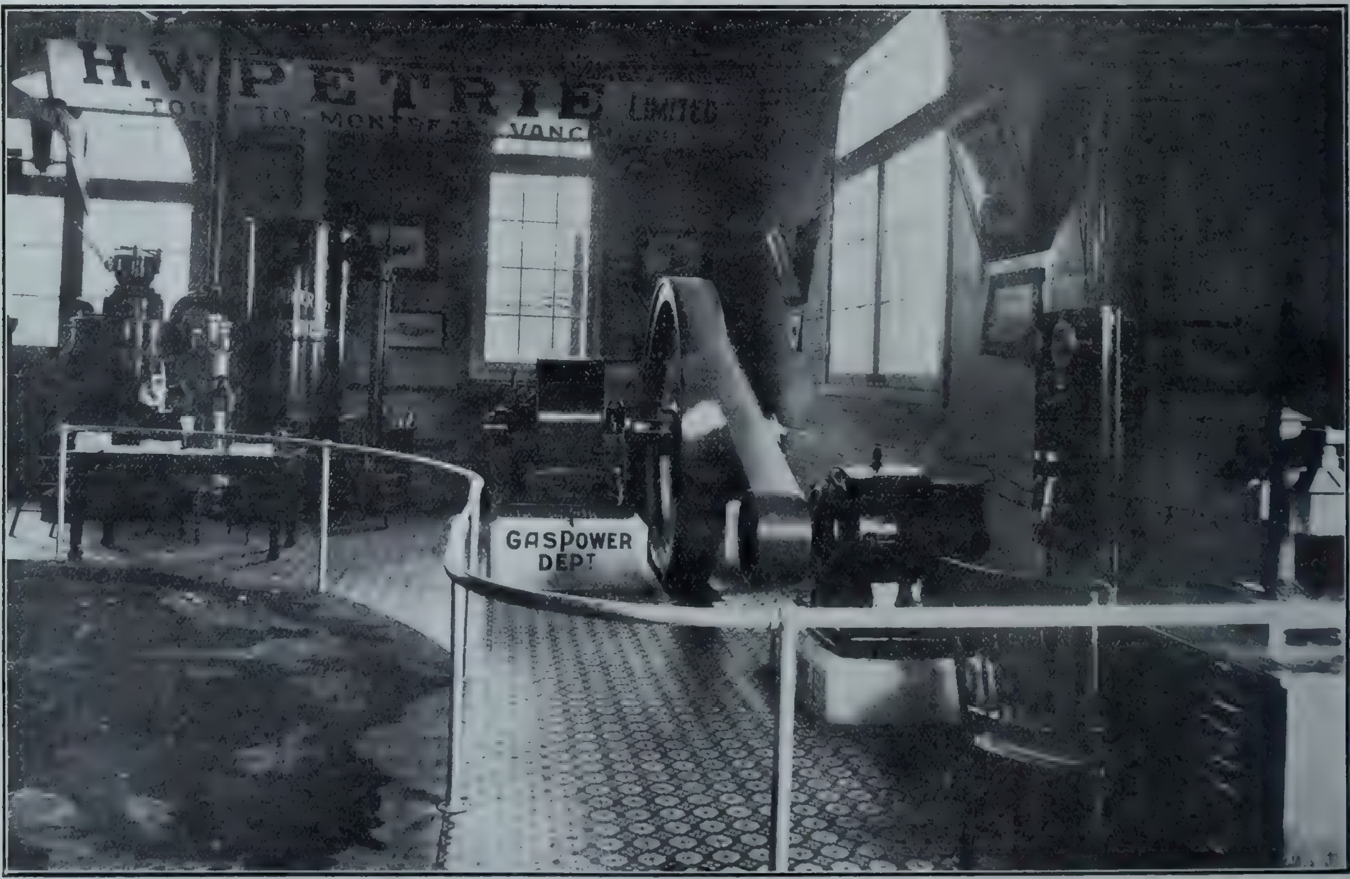

Fig. 1.—Keighley Suction Gas Producer and Engine at Canadian National Exhibition.

chamber D. As the engine draws the gas into the cylinder, it is drawn through the pipe G. The excelsior in expansion chamber is for the purpose of catching any odd particles of dirt that may get through this scrubber.

Cost of Gas Power.

The Doherty Mfg. Co., Sarnia, have installed a 75 h.p. Keighley gas engine at their stove works. They have used it six months, and report a saving of 70 per cent. over the previous system of generating power. The engine is run on natural gas, Sarnia being in the natural gas belt.

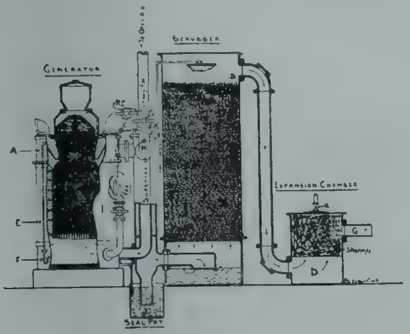

Fig. 3.—Keighley Gas Engine at Exhibition.

The makers claim that with anthracite coal as fuel seven-eighths of a pound per horse-power hour. This means that for 65 h.p., which was the capacity of the engine at the Exhibition, less than 57 lbs. of fuel of good quality are required per hour if the engine is working at its full capacity.

The engine ran from 9 a.m. to 10 p.m., thirteen hours, continuously, the only cleaning that was done being at 8.45 a.m., before starting up for the day. The amount of coal required for 13 hours is 741 lbs. At a cost of $4 per ton this would be $1.48 for 13 hours. For a day of ten hours, figuring at this rate, the cost would be $1.14 for a 65 h.p. engine, providing the whole load is being utilized. If the load is less, the consumption of fuel will be reduced correspondingly.

DESIGN AND MANAGEMENT OF ELECTRIC POWER PLANT.

(Continued from page 49.)

well, and when painted would have taken much less time to do and less paint.

Again, it is very nice to see artistically designed doorways, windows, etc., with carved wood work, where such are in keeping with the surroundings, but woodwork has a bad habit of drying and cracking; so that to go to the expense of putting anything but the plainest doors and windows into a power house is needless extravagance, yet the writer has seen it often done.

But it is not in avoiding needless things like the above that simplicity of design is to be alone directed but in the arranging of the lay-out of the plant as well. Some power houses seem as if the plant had been pitched in anyhow, allowed to sort itself out as best it could, and then the engines coupled to the boilers, the whole set going and allowed to go on irrespective of the fact that by more judicious arrangement, yards of piping might have been saved, which, in the case of steam pipes means loss of coal and water, more joints to keep tight, and more heat to bear in what, in summer time will be a quite hot enough engine room.

In a gas engine the heat is immediately converted into work, hence its high efficiency, but with steam, the heat has to be transmitted from the boiler to the engine, and therefore, the distance between the two should be as short as possible.

A single wall is sufficient to divide the boiler house from the engine house and by placing the cylinder ends of the engines nearest to the boilers much steam piping can be saved, with a corresponding saving in losses from radiation and condensation.

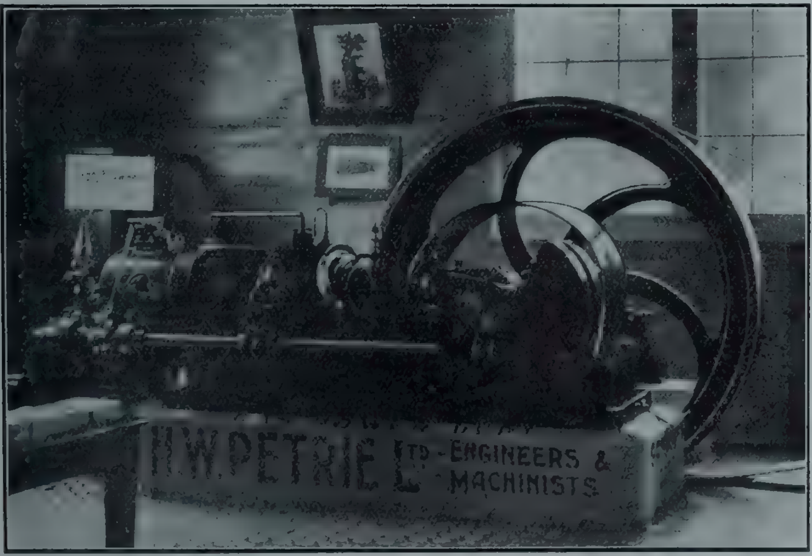

Fig. 2.—Section of Keighley Producer Gas Plant.

Power Plant Design.

The sketch, Fig. 1, will show better than anything else, how a plant can be designed when apparently the designer is only considering his commission on the materials used.

It will be noticed that the boiler-house is removed by more than half its own length from the engine house, and that all that length of pipe is exposed to the air, which in winter time will be attended by results too obvious to mention. In the engine room too will be noticed a decidedly poor arrangement of the engines. Causing considerably more steam and exhaust piping to be used than would have been necessary if a better "lay-out" had been planned in the first case.

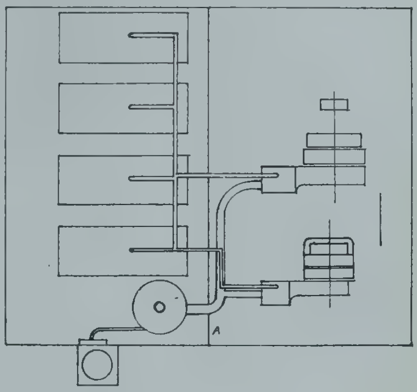

Fig. 2.—Shows the Plant Arranged so as to Avoid the Disadvantages Mentioned. A Door Placed at "A" Would Give Access to Engine Room and Boiler House.

Then with regard to the heater which warms the water supply to the boilers, by the exhaust steam passing through it, there is a waste of piping here also, and as it is burried several feet in the ground to provent freezing, it warms the ground up to no purpose whatever.

Nor is this all, by having the heater in the boiler-house and the boiler-house directly against the engine house, quite a saving would have been effected in ground space, building materials and labor, whereas in the above case all are separatėly housed.

One would think that such a design as the above would never be considered by any engineer, but such has actually been erected.

Had the arrangement been as shown in Fig. 2, all the foregoing disadvantages would have been avoided, and their corresponding advantages gained.

N. Graburn, lately superintendent of the mechanical and electrical engineering department of the Montreal Street Railway, has secured some agencies in the mechanical and electrical engineering lines, and has left Montreal for Vancouver.

POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

British Columbia.

NELSON.—The application of the Pacific Exploration Co. for permission to erect a large electric power plant on the Pend d'Oreille river, near Waneta, has been granted and plans of the proposed huge plant with a daily capacity of 25,000 horse-power and so built that the capacity may be doubled will be forwarded for consideration of the lieutenant-governor-in-council. The president of the new company is H. C. Hall, of Nelson; J. W. Falls is manager and A. Y. Lorch secretary. A considerable amount of Nelson capital is involved. The promoters of the new enterprise expect to furnish electric power to the Pend d'Oreille valley, the Sheep Creek and Ymir districts, and to the Orient, Chewela, and Metaline districts.

VANCOUVER.—The B.C. Market Co., have had their meat markets equipped with three 2-ton Sayre refrigerating plants supplied by P. L. Serwe & Co., Seattle, Wash., who also furnish a 2½-ton plant for the Vancouver General Hospital.

SARDIS.—Barr & Chambers have equipped their meat market with a 4-ton Sayre refrigerating plant.

FERNIE.—The big flume in connection with the Bull River Electric Power Company's installation is almost completed. The flume is 9,200 feet long, 16 feet wide and 7 feet 6 inches deep. Some 300 feet below the end of the flume the power house is situated on the banks of the Bull river. A theoretical head of 290 feet is obtainable, with which about 30,000 horse-power can be developed. Bull river empties into the Kootenay river in the neighborhood of Cranbrook, B.C.

Alberta.

MEDICINE HAT.—Bids will be received by D. Milne, mayor, for furnishing two direct connected gas engines driven 125 k.w. alternating current units, each engine to be capable of delivering not less than 200 b.h.p. on natural gas of 1,100 b.t.u. per cubic foot.

Saskatchewan.

YORKTON.—This municipality has engaged W. E. Skinner, of Winnipeg, as consulting engineer to supervise the installation of its thirty-five thousand dollar electric light system. Tenders will be called for immediately for steam, oil and gas producer plants and work on the pole line will commence as soon as possible so as to have the same erected before the frost sets in. It is hoped to have the plant in operation by February 1st.

MOOSE JAW.—The Canadian Boving Co., Toronto, manufacturers of high and low lift centrifugal pumps, water wheels and governors, etc., have received an order, through J. B. McRae, for 200 b.h.p. Diesel engines for the Moose Jaw street railway. These engines are manufactured by Mirrlees, Bickerton & Day, Stockport, England.

WEYBURN.—The contract for an extension to the electric light plant at this place has been awarded by G. V. Reed, to Allis-Chalmers-Bullock, Winnipeg, at $8,600.

SASKATOON.—The tender of the Robb Engineering Co., for the new 250 h.p. water-tube boiler, has been accepted.

Manitoba.

WINNIPEG.—The T. Eaton Co., will equip their branch store in this city with an 8-ton refrigerating plant, contract for which was let to the York Mfg. Co., York, Pa.

ST. BONIFACE.—Negotiations which have been under way for some months between the town of St. Boniface, and the Great Falls Power Co., represented by Mr. C. Chamberlain, resulted on the 8th inst. in the council of St. Boniface authorizing Mayor Bleau and the city clerk to sign a contract with the company for the supply of power, the following being some of the principal conditions. Three-phase, 60-cycle, 2,200-volt is to be supplied at the city's substation to be erected in St. Boniface by the 1st of January, 1912. The prices to be paid are to be based on the amount of power required by the city. 3,000 horse power is to be taken at first at a price of $22 per horse power. For 4,000 horse power the rate is to be $20; for 5,000 horse power, $18, and for quantities above 5,000 horse power a minimum rate of $17 is to be charged per horse power per annum. The power is to be measured on the low tension bus bars. The company is to furnish a bond of $20,000, as a guarantee of the performance of their part of the contract, at the time the contract is signed. The company is to build and maintain its transmission line from the generating station to the substation in St. Boniface, which, though it is not definitely stated in the contract, is evidently to be built by the city. The company is to guarantee a voltage regulation of not to exceed five per cent. above or below normal.

Ontario.

LONDON.—Contracts for the new pumping station at Springbank are to be awarded in the near future.

LONG BRANCH.—One hundred horse-power has been contracted for, to be supplied by the Erindale Power Co.

TILLSONBURG.—By a large majority the ratepayers have endorsed the by-law providing $25,000 to distribute hydro-electric power in the municipality.

DUNDAS.—The Chapman Engine & Mfg. Co., has been incorporated with a capital of $200,000. Provisional directors of the company are Stephen H. Chapman, Frederick W. Chapman, Arthur C. Morris, Albert Ogden and William G. Anderson.

FORT WILLIAM.—The Coalette Fuel Co., manufacturers of pressed coal are to be established here, and work on the new plant is to be commenced immediately.

TORONTO.—The Harris Abattoir Co. are making extensions of their plant and will add a 40-ton refrigerating machine, contract for which, compression side, piping, etc., was let to the York Mfg. Co., York, Pa.

TORONTO.—T. Eaton Co., Ltd., will improve the refrigerating plant in their department store by addition of an 8-ton and a 4-ton refrigerating machine, both of which will be furnished by the York Mfg. Co., York, Pa.

HAMILTON.—A company has been organized by parties from Buffalo, N.Y., and from Philadelphia, who will establish an ice making plant of about 30 to 50 tons daily capacity. Plans have been completed and work on building will commence in September, plant to be completed May 1, 1911.

OTTAWA.—The Rideau Club will equip its club house with a 4-ton refrigerating plant, contract for which was let to the York Mfg. Co., York, Pa.

OTTAWA.—A new contract has been made by the Hydro-Electric Power Commission for the delivery of 1,500 addition horsepower to be used in Ottawa and Hull, the price to be $15 per horsepower. Some months ago the Power Commission contracted to deliver 1,500 horsepower to Ottawa, and this was used for municipal purposes, such as lighting, etc. Later the order was increased by 1,000 horsepower. The present order will bring the total delivery up to 4,000 horsepower.

ORILLIA.—At a recent meeting of the council it was decided to spend immediately $10,000 in improving the power plant. A by-law will be submitted to the ratepayers asking them to authorize the expenditure. The installation of a new unit and greater wheel capacity must, however, follow within a year or two, and this will entail a probable expenditure of from $25,000 to $30,000.

GALT.—The council, in addition to awarding the contract for the step-down transformers for hydro-electric power to the Packard Electrical Co. have also placed an order with the same company for all of the service transformers to be used in distributing the power in Galt. The step-down transformers are composed of three 150 k.w. units. The service transformers total about 500 k.w., made up of 60 units, varying in size from 3 to 20 k.w.

HAMILTON.—The Smart-Turner Machine Co., Ltd., report the following recent pump orders: E. Long Mfg. Co., Orillia; T. J. McCutcheon, Dunnville; James Cornhill, Chatham; Randolph McDonald Co., Norwood; Evans Co., Sudbury; Monarch Knitting Co., Dunnville; Mr. Nairn, Bartonville, Ont.; St. Joseph's Convent, Toronto; Niagara Brand Spray Co., Burlington, Ont.; Great Lakes Dredging Co., Port Arthur; Ontario Iron and Steel Co., Welland; and S. C. Allen, Alliston, Ont. The pumps are of various kinds.

CAMPBELLFORD.—The Northumberland-Durham Power Co. has sold its property at Healy Falls to the Seymour Power & Electric Co., which the latter proposes to develop within the next couple of years, the date depending on the completion of the government work on the canal and dam there. About 15,000 horse-power, is available at this point, operating under a 76-foot head.

TORONTO.—A. B. Anderson, manager and president of Ferranti, Limited, head office Lancashire, England, is on a trip across Canada. Mr. Anderson expressed himself as well pleased with Canadian conditions and business prospects.

NIAGARA FALLS.—The Hydro-electric Commission's transmission line between the Falls and Berlin was tested Sept. 4, a current of 110,000 volts being sent over the line from here. The test was most successful.

Quebec.

MONTREAL.—The Jeffrey Mfg. Co., office and works, corner Cote and Lagauchetiere Streets, Montreal, also having a Toronto office formerly in the Dineen Bldg., 8 Temperance Street, has removed the Toronto office to more commodious

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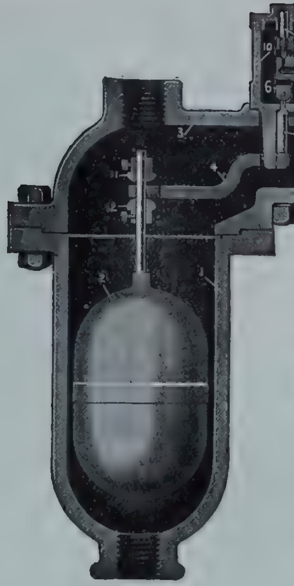

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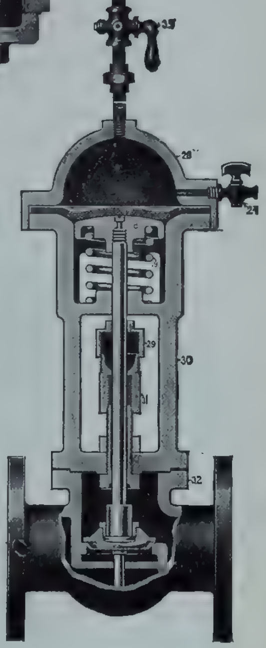

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quarters at 174 King Street East. Mr. H. W. Scott, mechanical engineer, formerly connected with the home office of this company in Columbus, O., is now in charge of the Montreal office and works. The Jeffrey Mfg. Co. are an old established concern, making a specialty of elevating and conveying apparatus for handling all kinds of materials in lumber camps, mines, quarries, as well as conveying apparatus for handling materials from the docks, loading to vessels. New machinery has been installed at the Montreal works for more economical production. This company also has nearly 100 branch offices situated in the leading commercial centres all over the world.

FARNHAM.—Work on the new power development at Farnham, is progressing favorably. The contract for the supply and installation complete of two 300 k.w. generators, exciters and switchboard was awarded recently to the Canadian Fairbanks Co. The Canadian Boving Co. were the successful tenderers for the water-wheel equipment and governors which contract includes the supply and installation of two sets of water wheels, two governors and all accessories. Ross & Holgate, Montreal, are the supervising and designing engineers.

Nova Scotia.

STELLARTON.—The Acadia Coal Co., are contemplating the installation of a 2,200 kilowatt electric plant at what is known as the Allan Shaft in Stellarton, to be used in driving their machinery and for general lifting purposes.

Seaforth for Hydro-Electric.

The rate payers of Seaforth voted in favor of three by-laws. The first asked for a guarantee of the bonds of the Bell Engine and Thresher Co. to the sum of $50,000, to permit of the enlargement and extension of the present plant for the purpose of manufacturing gasoline traction engines for the western trade. The second was for the acceptance of Hydro-Electric power, and the third drovided for the voting of $25,000 for the installation of an electric lighting and power system.

CATALOGUES.

GASKETS.—The merits of the McKim gasket are set forth in a neat booklet entitled "Heart Trouble in your Power Plant," issued by the McCord Mfg. Co., Detroit. The history of the gasket is given, and the cure for the beforementioned ailment set forth. In addition letters from satisfied users bear testimony to its efficacy.

ENGINE AND BOILER MOUNTINGS.—The 66 page catalogue issued by Allen, Harrison & Co., Knott Mill, Manchester, England, is an illustrated price list of the large line of fittings they manufacture. The following are among the articles listed: Wheel, check, compound, steam and water, and bronze wheel valves, gland and main steam and bronze blow-off cocks, boiler feed valves, check valves and gland cocks combined, bronze and cast iron throttle valves, bronze reducing valves, safety valves, water gauges, gauge glass protectors, Bourdon pressure and vacuum gauges, engine counters, fusible plugs, screw cap lubricators, glass needle lubricators, grease cups, suet lubricators, oil syphons, sight feed oil syphons and oil boxes, sight feed lubricators, steam cylinder lubricator, mechanical lubricator, gauge cocks, injectors, exhaust steam injectors, steam nozzles, water director, steam traps, return steam traps, steam whistles, indicators and indicator cocks, wrought iron tubes and fittings, fire hose fittings, hydrants, cast iron steam valves, sluice valves, retaining valves, foot valves, suction strainers, steam kettles, pickering governors, pans, mixing pans, backs and vats, cast iron tanks, locomotive mountings, foundry work, bronze bells and bearing metal.

WESTINGHOUSE POTENTIAL REGULATORS —Circular No. 1017 from the Canadian Westinghouse Co., Ltd., Hamilton, is a 40-page booklet describing this piece of apparatus. The book is replete with many illustrations, showing the details of the system, and also installation where it is a feature. The descriptive matter contains much useful knowledge.

ERIE CITY WATER TUBE BOILERS.—This is the subject of a 30 page, well gotten up catalogue, issued by the Jno. Inglis Co., Toronto, who are the sole Canadian manufacturers of this type of boiler. The various details of construction are completely described in an intelgible manner with many comprehensive illustrations. The theory of combustion is touched upon and its application in the Erie boiler fully emphasized. The many other special feature are well described and their advantages brought out.

DART UNIONS.—Under the significant title "Dart Unions; What They Are, and What They Do," the Dart Union Co., Toronto, have just issued a small eight-page booklet descriptive of these unions. Their essential points are: an all bronze ball joint; heavy iron thread ends; and neat finished castings and full threads. Dart unions are made in both screwed (or nut) and flange types, and may be used on steam, water, gas or air pipes. The ball-shaped seats make a perfect joint either in or out of line; the bronze face prevents corrosion and rust; their heavy construction adds length of life; and the Dart has all the advantages of the all-bronze union with the additional strength of iron ends. Dart unions claim the advantages of saving in upkeep cost; elimination of trouble in making joints; assurance of tight joints, allowing joints to be made innumerable times without expense; and also allow the joints as well as the pipes to be covered. Every Dart union and flange is guaranteed. Several colored illustrations of both screwed and flanged unions give a good idea of what these goods are like.

NOTES ON BELTING.

By J. Shields.

To measure the length of belting in a roll. To the outside diameter of the coil in inches add the inner diameter, also in inches; multiply by the number of coils in the roll, then by 0.1309. The product will give the length of the belt in feet. A coil 18-in. diameter, 3-in. inside diameter, with 15 coils, would contain, 18 in.+3 in.=21 in. 21×15=315. 315×0.1309=41.22 ft,,or 41 ft. 3 in. nearly. It is immaterial whether the roll is coiled tightly or loosely, provided it is coiled uniformly.

The slip on belts is generally from 2½ to 3 per cent. A good home-made dressing to prevent excessive slipping may be made as follows: Melt 1 pound of beeswax, then slowly add 1 gallon of neatsfoot oil, stirring constantly until well mixed. Another, but more expensive, can be made by mixing 1 lb. of India rubber in a pint of pure turpentine by putting in a vessel containing hot water nearly boiling, stirring until it combines in a perfect solution, then stirring in ¾-lb. beeswax, ½-lb. finely-powdered amber rosin, 1½-lb. clean Russian tallow; mix thoroughly and then place in a jar with 3 pints of whale oil. Stir well before using and apply with a piece of waste or a rag once a month.

When putting on a new belt, allow ⅛-in. per foot short for stretch. A belt measured with a tape line round pulleys, if found to measure 36 ft. it should be cut 35 ft. 7½ in. 3-16-in. to ¼-in. per foot may be allowed on canvas or rubber belts. Four-ply canvas or rubber belt is equal to single leather belt. Leather belting is injured by water, steam, oil, and temperatures above 110 deg. F. Under such conditions canvas or rubber belts may be advantageously used. A good plan to overcome narrow pulley troubles or to save exchanging pulleys to increase the horse-power is to compound the belt, by means of running the new belt on top of the old one. A single belt pulling 5 h.p. would pull 8 h.p. if compounded, making a 60 per cent. increase.

A safe margin for h.p. for belts is 1,000 ft. per minute for 1-in belts. To find the velocity of the belt, multiply the circumference of the pulley by the r.p.m. 3,500 to 4,000 ft. per minute is a good average for main drive belts. To run a belt at right-angles: The driver edge of the pulley lined to centre of the driven pulley will give entire satisfaction. The proportion between the diameters of pulleys working together should not exceed 6 to 1. The pulley should be about ½-in. to 1½ in. wider than the belts. It is bad policy to have driving centres too close, 15 in. is about as near as they should be, if possible. The lower side of the belt should be made the driving side.

Last month the first of the large caissons for the new foundations of the Quebec bridge was launched from the temporary works adjoining the bridge site. The new superstructure will be 30 feet wider than the old one, and the new centre line of the bridge has therefore been moved 15 feet up stream. The caisson measures 54 feet by 180 feet, and weighs 1,700 tons. The caisson of the south pier, 79 feet by 180 feet, will be the largest of its kind ever built.

A transformer for a current of 500,000 volts has been built by the General Electric Co., of Berlin, Germany, for experiments with insulating materials. The voltage of the current transformed is from 1,040 to 2,080 volts. The transformer proper is immersed in an oil tank containing 2,000 gallons of oil, which acts as insulating material. The transformer weighs 11,000 pounds without the oil, and has, with the oil tank, a length of 10 feet, a width of 6 feet, and a height of 8 feet, With the projecting high-pressure insulators the total height is nearly 15 feet.

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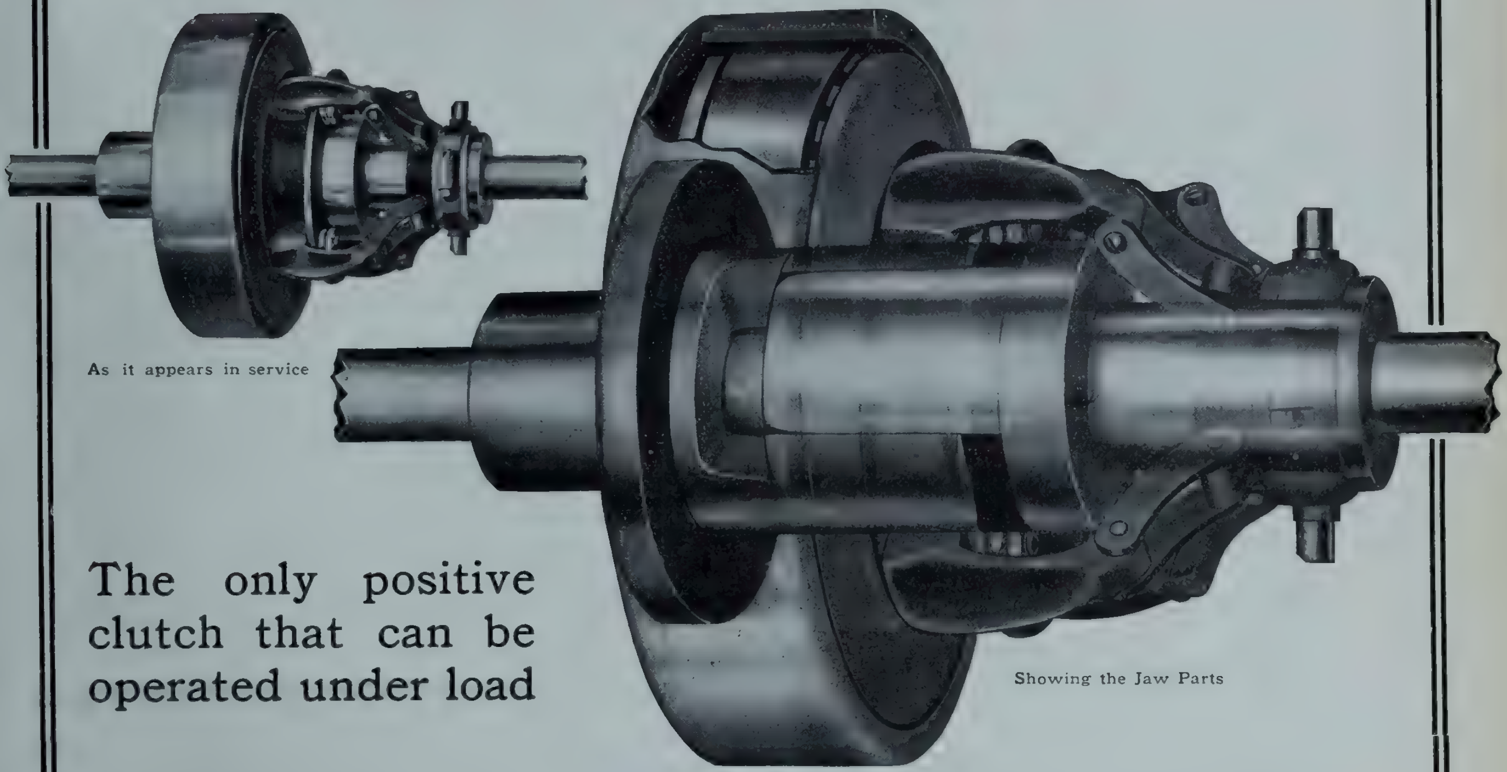

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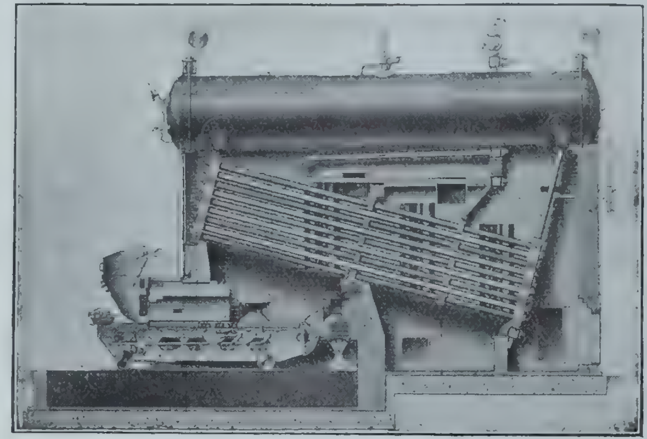

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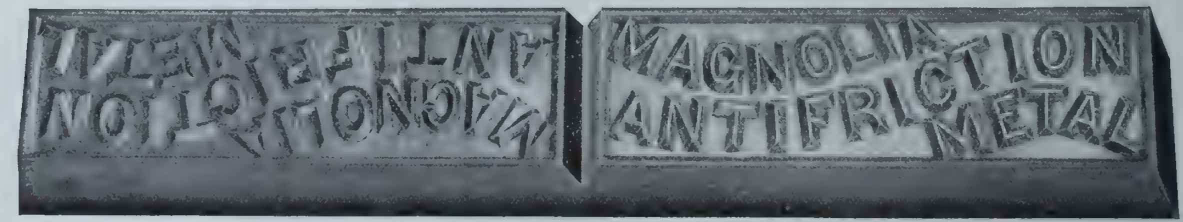

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Antifriction Metal.

Magnolia Metal Co., New York, N.Y.

Arches, Combustion Chamber

Canadian Fairbanks Co., Ltd., Montreal

Babbitt Metal.

Canada Metal Co., Toronto.
Canadian Fairbanks Co., Ltd., Montreal
Magnolia Metal Co., New York, N.Y.

Bearings, Ball.

Chapman Double Ball Bearing Co., Toronto

Bearings, Self-Oiling.

J. C. Wilson & Co., Glenora, Ont.

Belt Dressing.

Jos. Dixon Crucible Co., Jersey City
C. C. Snowdon, Calgary

Belt Tighteners.

Waterous Engine Works Co., Brantford.

Belting, Leather.

Canadian Fairbanks Co., Ltd., Montreal
Dominion Belting Co., Hamilton, Ont.
Imperial Waste & Metal Co., Montreal
J. D. McArthur, Brockville
D. K. McLaren, Ltd., Montreal.
Sadler & Haworth, Montreal.

Bending, Pipe.

National Pipe Bending Co., New Haven, Conn.

Blowers.

Canadian Fairbanks Co., Ltd., Montreal
Matthews & Yates, Manchester
Turbo-Blower Co., New York

Boiler Compounds.

Dearborn Drug and Chemical Works, Chicago, Ill.
Electric Boiler Compound Co., Guelph, Ont.
Hygienic Laboratories, Toronto
International Boiler Compound Company, Chicago
Geo W. Lord Co., Philadelphia
C. C. Snowdon, Calgary

Boiler Compound Feeders.

Canadian Fairbanks Co., Ltd., Montreal
Hygienic Laboratories, Toronto
Michigan Lubricator Co., Detroit
Morehead Mfg. Co., Detroit, Mich.

Boiler Feed Pumps.

Canadian Fairbanks Co., Ltd., Montreal
Canadian Steam Boiler Equipment Co. Toronto
Darling Bros., Montreal

Boiler Feed Regulators.

Canadian Fairbanks Co., Ltd., Montreal
Peiler & MacKenzie, Montreal
Standard Engineering Co., Toronto.

Boiler Feed Water Regulators.

Canadian Fairbanks Co., Ltd., Montreal

Boiler Mountings.

Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal
Darling Bros., Montreal
The John Inglis Co., Ltd., Toronto
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
Peiler & MacKenzie, Montreal

Boiler Settings.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Boiler Tube Cleaners.

The Paul B. Huyette Co., Philadelphia
Liberty Mfg. Co., Pittsburg
Michigan Lubricator Co., Detroit
Peiler & McKenzie, Montreal, Que.
Wm. B. Pierce Co., Buffalo

Boilers.

Babcock & Wilcox, Montreal
Goldie & McCulloch Co., Galt.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jones Underfeed Stoker Co., Montreal.
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.
The Wm. Hamilton Co., Peterborough

Boilers, Horizontal Tubular.

Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough, Ont.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Boilers, Locomotive

Jno. Inglis Co., Ltd., Toronto
Goldie & McCulloch Co., Galt, Ont.
The Wm. Hamilton Co , Peterborough

Boilers, Marine.

Babcock & Wilcox, Montreal
Goldie & McCulloch Co., Galt.
The Wm Hamilton Co., Peterborough.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Boilers, Vertical.

Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Boilers, Water Tube.

Babcock & Wilcox, Montreal
The John Inglis Co., Ltd., Toronto
Polson Iron Works, Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.

Boosters.

Geo. C. Royce, West Toronto

Brine Coolers.

Vilter Mfg. Co., Milwaukee, Wis.

Canners' Machinery.

J. C. Wilson & Co., Glenora, Ont.

Cars, Transfer.

Corbet Foundry and Machine Co., Owen Sound

Castings, Brass.

Hercules Float Works, Springfield, Mass,
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
J. C. Wilson & Co., Glenora, Ont.

Cement Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
Jno. McDougall Caledonian Iron Works, Montreal

Chemicals.

Dearborn Drug and Chemical Works Chicago
Nichols Chemical Mfg. Co., Montreal
C. C. Snowdon, Calgary

Circuit-Breakers.

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Clutches.

Positive Clutch & Pulley Works, Toronto

Coal and Ash Conveyors.

Babcock & Wilcox, Montreal
Peiler & McKenzie, Montreal, Que.

Coal Handling Machinery

Standard Engineering Co., Toronto

Cold Storage Architects.

E. J. Greenstreet, Toronto

Condensers.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
Goldie & McCulloch Co., Galt.
Jno. Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Peiler & McKenzie, Montreal, Que.
Vilter Mfg. Co., Milwaukee, Wis.

Consulting Engineers.

Bayfield & Archibald, Vancouver, B.C.
de Gaspe Beaubien, Montreal.
Rowland Brittain, Vancouver, B.C.
W. S. Brooke, Toronto
Cleveland & Cameron, Vancouver, B.C.
Dutcher & Foreman, Vancouver, B.C.
John T. Farmer, Montreal
Walter J. Francis, Montreal.
J. F. Frew, Vancouver, B.C.
Galt & Smith, Toronto.
E. J. Greenstreet, Toronto
John S. Isdale, Vancouver, B.C.
F. M. G. Johnson, Montreal
Laurie & Lamb, Montreal
Marchand & Donnelly, Ottawa, Ont.
Ralph D. Mershon, Montreal
C. H. & P. H. Mitchell, Toronto
Moore & Scollan, Toronto
John B. McRae, Ottawa
Morris Engineering Co., Vancouver, B.C.
J. M. Robertson, Montreal.
J. M. Shanly, Montreal.
Standard Engineering Co., Toronto
C. S. Youle, Victoria, B.C.

Contractors, Structural Steel

Canadian Fairbanks Co., Ltd., Montreal
Corbet Foundry and Machine Co. Owen Sound

Conveyor Machinery.

Canadian Fairbanks Co., Ltd., Montreal
Jno. McDougall Caledonian Iron Works, Montreal

Cork Insulation.

Canadian Fairbanks Co., Ltd., Montreal
Linde British Refrigeration Co., Montreal

Couplings.

Canadian Fairbanks Co , Ltd , Montreal
J. C. Wilson & Co., Glenora, Ont.

Cranes, Electric.

Babcock & Wilcox, Montreal
Jno. McDougall Caledonian Iron Works Montreal

Crank Pins.

Michigan Lubricator Co., Detroit

Crank Pin Oilers.

Lunkenheimer Co., Cincinnati, Ohio

Cross Head Pins.

Michigan Lubricator Co., Detroit

Cross Head Pin Oilers.

Lunkenheimer Co., Cincinnati, Ohio

Crushing Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
The Wm. Hamilton Co., Peterborough

Damper Regulators.

Darling Bros., Montreal
Julian d'Este Co., Boston, Mass.
Peiler & MacKenzie, Montreal

Dredges.

Allis-Chalmers-Bullock, Ltd., Montreal

Drills, Rock.

Allis-Chalmers-Bullock, Ltd., Montreal

Drying Machinery.

Canadian Fairbanks Co., Ltd., Montreal
Jno. Inglis Co., Ltd., Toronto

Dynamos.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd , Montreal
Canadian Westinghouse Co., Hamilton
Mechanical & Elec. Lab., Buffalo
Electrical Maintenance & Repair Co., Toronto.

Economizers.

Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal

Electric Power Instalations.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton

Electric Fans.

Matthews & Yates, Manchester

Electrical Accessories.

Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Toronto

Electrical Machinery.

Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker Toronto

Electrical Repairs.

Electrical Maintenance & Repair Co., Toronto.
Northern Electric Supply Co., Orillia, Ont.

Elevating Machinery.

Canadian Fairbanks Co., Ltd., Montreal
Goldie & McCulloch Co., Galt.
The John Inglis Co., Ltd., Toronto
Waterous Engine Works Co., Brantford.

Engines, Automatic.

The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works Montreal
Robb Engineering Co., Amherst, N.S.

Engines, Corliss.

Allis-Chalmers-Bullock, Ltd., Montreal
Goldie & McCulloch, Co., Galt.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.
Vilter Mfg. Co., Milwaukee, Wis.

Engines, Gas and Gasoline.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Drummond, McCall & Co., Montreal
Fielding & Platt, Ltd., Gloucester, Eng.
Jno. McDougall Caledonian Iron Works, Montreal

Engines, High Speed, Steam.

Goldie & McCulloch Co., Galt.
The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Engines, Marine

Canadian Fairbanks Co., Ltd., Montreal
Jno. Inglis Co., Ltd., Toronto

Engines, Medium and Low Speed.

Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough.
The John Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Engines, Rocking Valve.

The John Inglis Co., Ltd., Toronto

Engines, Saw Mill.

Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough.
The John Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford

Engines, Single, Compound and Triple Expansion.

Drummond, McCall & Co., Montreal
The Wm. Hamilton Co., Peterborough.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Laurie & Lamb, Montreal
Jno. McDougall Caledonian Iron Works, Montreal
Kerr Engine Co., Walkerville
Robb Engineering Co., Amherst. N.S.
Waterous Engine Works Co., Brantford

Engines, Slide Valve

Jno. Inglis Co., Ltd., Toronto
The Wm. Hamilton Co., Peterborough

Engines, Vertical.

The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.

Engine Stops.

Strong, Carlisle & Hammond Co., Cleveland

Exhaust Fans.

Matthews & Yates, Manchester

Exhaust Heads.

Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
Standard Engineering Co., Toronto.
Watson & McDaniel Co., Philadelphia

Feed Water Alarms.

Peiler & McKenzie, Montreal, Que.
Reliance Gauge Column Co., Cleveland, Ohio

Feed Water Analyser.

Dearborn Drug and Chemical Works, Chicago
C. C. Snowdon, Calgary

Feed Water Heaters

Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal
Canadian Steam Boiler Equipment Co., Toronto
Darling Bros., Montreal
Goulds Pump Co., Montreal.
The Wm. Hamilton Co., Peterborough.
The John Inglis Co., Ltd., Toronto
C. Jacobs & Co., Boston, Mass.
National Pipe Bending Co., New Haven, Conn.
Peiler & MacKenzie, Montreal
Robb Engineering Co., Amherst, N.S.
Standard Engineering Co., Toronto
The Stewart Heater Co., Buffalo, N.Y.

Feed Water Regulators

Liberty Mfg. Co., Pittsburg, Pa.
Peiler & McKenzie

Filters, Pressure

Jno. McDougall Caledonian Iron Works Montreal

Fire Brick.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Flanges

Dart Union Co., Toronto

Flumes, Steel.

Corbet Foundry and Machine Co., Owen Sound
The Wm. Hamilton Co., Peterborough
The John Inglis Co., Ltd., Toronto

Furnace Linings.

Harbison-Walker Refractories Co., Pittsburg, Pa.

Fuses.

Geo. C. Royce, West Toronto

Gas Producer Linings.

Harbison.Walker Refractories Co., Pittsburg, Pa.

Gas Producer Plants.

Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Drummond, McCall & Co., Montreal
Fielding & Platt, Ltd., Gloucester, Eng.

Gauge Cocks.

Canadian Fairbanks Co., Ltd., Montreal
The Paul B. Huyette Co , Philadelphia
Lunkenheimer Co., Cincinnati, Ohio
Peiler & McKenzie, Montreal, Que.
Reliance Gauge Column Co., Cleveland, Ohio

Gauges, Pressure, Vacuum and Recording.

Babcock & Wilcox, Montreal
Lunkenheimer Co., Cincinnati, Ohio
Peiler & MacKenzie, Montreal

Gears, Angle.

The Wm. Hamilton Co., Peterborough
Jno. McDougall Caledonian Iron Works, Montreal
J. C. Wilson & Co., Glenora, Ont.

Gears, Cut.

J. C. Wilson & Co., Glenora, Ont.
The Wm. Hamilton Co., Peterborough

Gears, Mortise.

J. C. Wilson & Co., Glenora, Ont.
The Wm. Hamilton Co., Peterborough

Gears, Reducing

Jno. McDougall Caledonian Iron Works. Montreal

Gears, Worm.

J. C. Wilson & Co., Glenora, Ont.
The Wm. Hamilton Co., Peterborough

Generators.

Allis-Chalmers-Bullock, Montreal
Canadian Electrical & Motor Co., Toronto
Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto

Governors.

Allis-Chalmers-Bullock, Ltd., Montreal

Governors, Water Wheel.

J. C. Wilson & Co., Glenora, Ont.

Graphite.

Jos. Dixon Crucible Co., Jersey City
C. C. Snowdon, Calgary

Grates.

Babcock & Wilcox, Montreal
Butterworth Foundry Co., Ottawa
Canadian Steam Beiler Equipment Co. Toronto
Peiler & McKenzie, Montreal, Que
[illegible]
The John Inglis Co., Ltd., Toronto

Gravity Closing Ventilators.

Standard Engineering Co., Toronto.

Grease Cups.

Detroit Lubricator Co., Detroit.
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit

Grease and Oil Extractors.

C. Jacobs & Co., Boston, Mass.
C. C. Snowdon, Calgary

Greases

Canadian Fairbanks Co., Ltd., Montreal
Canadian Oil Companies, Toronto
Jos. Dixon Crucible Co., Jersey City
Electric Boiler Compound Co., Guelph.
C. C. Snowdon, Calgary

Hangers.

Canadian Fairbanks Co., Ltd., Montreal
Goldie & McCulloch Co., Galt.
Jno. McDougall Caledonian Iron Works, Montreal
Positive Clutch & Pulley Works, Toronto
Waterous Engine Works Co., Brantford
J. C. Wilson & Co., Glenora, Ont.
The Wm. Hamilton Co., Peterborough

Heating Apparatus.

Matthews & Yates, Manchester

Heaters.

Darling Bros., Montreal
Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough
The John Inglis Co., Ltd., Toronto
Peiler & McKenzie, Montreal, Que.
The Stewart Heater Co., Buffalo, N.Y.

Hydraulic Accumulators.

The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

Hydraulic Machinery.

The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

Ice Making Machinery.

Linde British Refrigeration Co., Montreal
Vilter Mfg. Co., Milwaukee, Wis.

Indicators, Electric—All Types.

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Indicators, Steam Engine.

Canadian Fairbanks Co., Ltd., Montreal
Peiler & MacKenzie, Montreal

Indicators, Water.

Detroit Lubricator Co.. Detroit

Injectors.

Detroit Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati, Ohio
Jas. Morrison Brass Mfg. Co., Toronto
Penberthy Injector Co., Windsor.

Iron Filler.

Imperial Waste & Metal Co., Montreal

Lamps, Arc.

Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton

Lamps, Incandescent

Canadian Westinghouse Co., Hamilton
Chapman & Walker, Toronto

Lubricants.

Jos. Dixon Crucible Co., Jersey City
C. C. Snowdon, Calgary

Lubricators, Force Feed.

Darling Bros., Montreal
Detroit Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati
Michigan Lubricator Co., Detroit
Richardson-Phenix Co., Milwaukee, Wis

Lubricators, Plain.

Detroit Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati, Ohio

Maple Cogs.

The Wm. Hamilton Co., Peterborough
J. C. Wilson & Co., Glenora, Ont.

Mechanical Stokers.

Babcock & Wilcox, Montreal
Jones Underfeed Stoker Co., Montreal.
Standard Engineering Co., Toronto

Meters, Electric

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto.

Meters, Water

Drummond, McCall & Co., Montreal
Peiler & MacKenzie, Montreal

Mill Machinery.

Allis-Chalmers-Bullock, Ltd. Montreal
Canadian Fairbanks Co., Ltd., Montreal
Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
Madison Williams Mfg, Co., Lindsay,Ont
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co.. Brantford
J. C. Wilson & Co., Glenora, Ont.

Mining Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
The Wm. Hamilton Co., Peterborough
Jno. Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

Motors.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Electrical Maintenance and Repair Co. Toronto.

Motor Controllers.

Canadian Westinghouse Co., Hamilton

Motor Starters.

Canadian Westinghouse Co., Hamilton
Chapman & Walker, Ltd., Toronto
Geo. C. Royce, West Toronto

Oilers, Gang.

Michigan Lubricator Co., Detroit
Sight Feed Oil Pump Co., Milwaukee, Wis

Oilers, Multiple.

Detroit Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati, Ohio

Oil Filters

Darling Bros., Montreal
Liberty Mfg. Co., Pittsburg, Pa.
Richardson-Phenix Co., Milwaukee, Wis

Oil and Waste Saving Machines.

Canadian Oil and Waste Saving Machin Co., Brockville, Ont.

Oil Separators.

Albany Steam Trap Co., Albany, N.Y.
Babcock & Wilcox, Montreal
Canadian Fairbanks Co., Ltd., Montreal
Canadian Steam Boiler Equipment Co. Toronto
Darling Bros., Montreal
C. Jacobs & Co., Boston, Mass.
Liberty Mfg. Co., Pittsburg
Peiler & MacKenzie, Montreal
Standard Engineering Co., Toronto

Oils, Lubricating.

Dearborn Drug and Chemical Works, Chicago
Electric Boiler Compound Co., Guelph Ont.
C. C. Snowdon, Calgary

Packing, Leather.

Electric Boiler Compound Co., Guelph Ont.
Garlock Packing Co., Hamilton

Packing, Metallic.

Peiler & McKenzie, Montreal, Que.

Penstocks.

The Wm. Hamilton Co., Peterborough
Jno. Inglis Co., Ltd., Toronto

Perforated Metals.

Allis-Chalmers-Bullock, Ltd., Montreal

Pipe Coils.

National Pipe Bending Co., New Have Conn.

Pipe Cutting and Threading Machines.

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Curtis & Curtis Co., Bridgeport, Conn

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The Wm. Hamilton Co., Peterborough

Pipes, Water.

Pacific Coast Pipe Co., Vancouver, B.C.

Piping, Steam,

Babcock & Wilcox, Montreal
Drummond, McCall & Co., Montreal
Imperial Waste & Metal Co., Montreal

Planimeters.

Peiler & MacKenzie, Montreal

Plate Work.

The John Inglis Co., Ltd., Toronto
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Waterous Engine Works Co., Brantford

Polish, Metal,

G. W. Hoffman, Indianapolis

Power Pumps.

Canadian Fairbanks Co., Ltd., Montreal
Darling Bros., Montreal
Drummond, McCall & Co., Montreal
The John Inglis Co., Ltd., Toronto
Goldie & McCulloch Co., Galt.
Goulds Pump Co., Montreal.
Waterous Engine Works Co., Brantford

Power Transmission Machinery.

Canadian Fairbanks Co., Ltd., Montreal
The Wm. Hamilton Co., Peterborough
The John Inglis Co., Ltd., Toronto
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Positive Clutch & Pulley Works, Toronto
The Stewart Heater Co., Buffalo, N.Y.
Waterous Engine Works Co., Brantford.
J. C. Wilson & Co., Glenora, Ont.

Presses, Hydraulic

The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

Processing Retorts.

J. C. Wilson & Co., Glenora, Ont.

Pulleys.

Canadian Fairbanks Co., Ltd., Montreal
Jno. McDougall Caledonian Iron Works Montreal
J. C. Wilson & Co., Glenora, Ont.
The Wm. Hamilton Co., Peterborough
Positive Clutch & Pulley Works, Toronto

Pumping Engines.

Jno. Inglis Co., Ltd., Toronto

Pulp Mill Machinery.

Jno. McDougall Caledonian Iron Works Montreal

Pumping Machinery.

Allis-Chalmers-Bullock, Ltd., Montreal
Canadian Fairbanks Co., Ltd., Montreal
Drummond, McCall & Co., Montreal
The Wm. Hamilton Co., Peterborough
Jno. Inglis Co., Ltd., Toronto

Pump Governors.

Albany Steam Trap Co., Albany, N.Y.
Canadian Steam Boiler Equipment Co. Toronto
Darling Bros, Montreal
Julian d'Este Co., Boston, Mass.
Liberty Mfg. Co., Pittsburg, Pa.
Peiler & MacKenzie, Montreal
Standard Engineering Co., Toronto.
Watson & McDaniel Co. Philadelphia

Pump Regulators.

Peiler & McKenzie, Montreal

Pump Strainers.

Canadian Steam Boiler Equipment Co., Toronto
Liberty Mfg. Co., Pittsburg, Pa.

Pumps, Air,

Canadian Fairbanks Co., Ltd., Montreal
The John Inglis Co., Ltd., Toronto
Lunkenheimer Co., Cincinnati, Ohio

Pumps, Centifrugal

Jno. Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

Pumps, Geared

Canadian Fairbanks Co., Ltd., Montreal
Jno. Inglis Co., Ltd., Toronto

Pumps, Oil.

Detroit Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
Richardson-Phenix Co., Milwaukee, Wis

Pumps, Steam

Canadian Fairbanks Co., Ltd., Montreal
The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works Montreal

Recorders.

Drummond, McCall & Co., Montreal

Refrigerating Engineers.

E. J. Greenstreet, Toronto

Refrigeration Machinery.

Linde British Refrigeration Co., Montreal
Vilter Mfg. Co., Milwaukee, Wis.

Reducing Valves.

Automatic Feed and Regulator Co., London
Peiler & McKenzie, Montreal

Reducing Wheels.

Peiler & MacKenzie, Montreal

Rheostats.

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

Rotary Convertors.

Canadian Fairbanks Co., Ltd., Montreal
Canadian Westinghouse Co., Hamilton

Safes.

Canadian Fairbanks Co., Ltd., Montreal
Goldie & McCulloch Co., Galt.

Safety Valves.

Canadian Fairbanks Co., Ltd, Montreal
Lunkenheimer Co., Cincinnati, Ohio
Peiler & MacKenzie, Montreal

Shafting.

The Wm. Hamilton Co., Peterborough
Goldie & McCulloch Co., Galt.
Jenckes Machine Co., Sherbrooke, Que.
Jno. McDougall Caledonian Iron Works, Montreal
Positive Clutch & Pulley Works, Toronto
Waterous Engine Works Co., Brantford,
J. C. Wilson & Co., Glenora, Ont.

Shaking and Dumping Grates

Babcock & Wilcox, Montreal
The John Inglis Co., Ltd., Toronto
Standard Engineering Co., Toronto

Smoke Boxes.

The Wm. Hamilton Co., Peterborough

Smoke Consumers.

Canadian Steam Boiler Equipment Co., Toronto

Smoke Stacks.

Babcock & Wilcox, Montreal
Corbet Foundry and Machine Co., Owen Sound
The Wm. Hamilton Co., Peterborough
The John Inglis Co., Ltd., Toronto
Jno. McDougall Caledonian Iron Works, Montreal

Special Machinery.

Canadian Fairbanks Co., Ltd, Montreal
Electrical Maintenance and Repair Co. Toronto.
The John Inglis Co., Ltd., Toronto

Sprocket Wheels.

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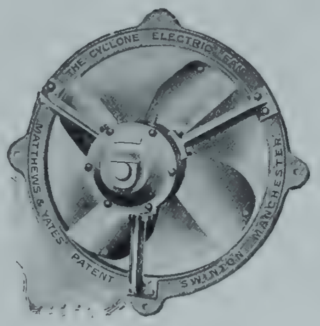

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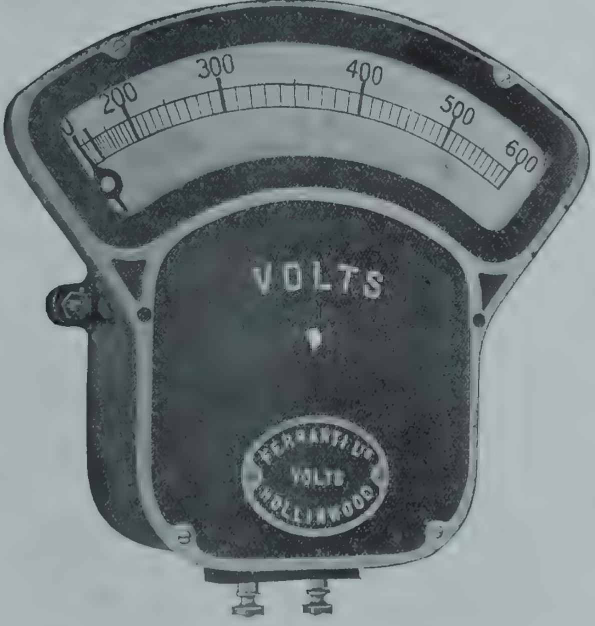

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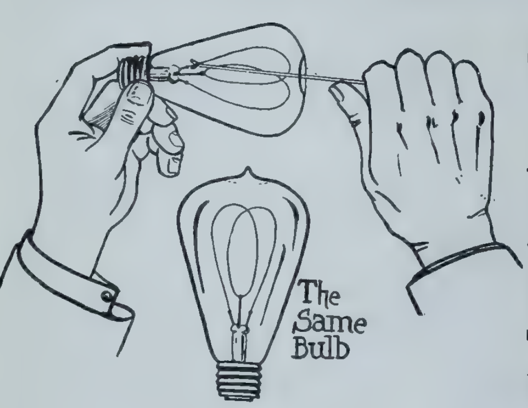

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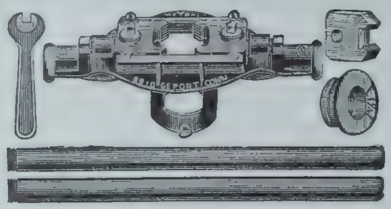

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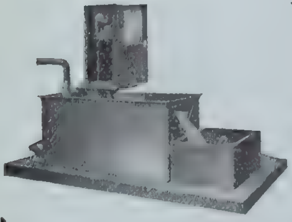

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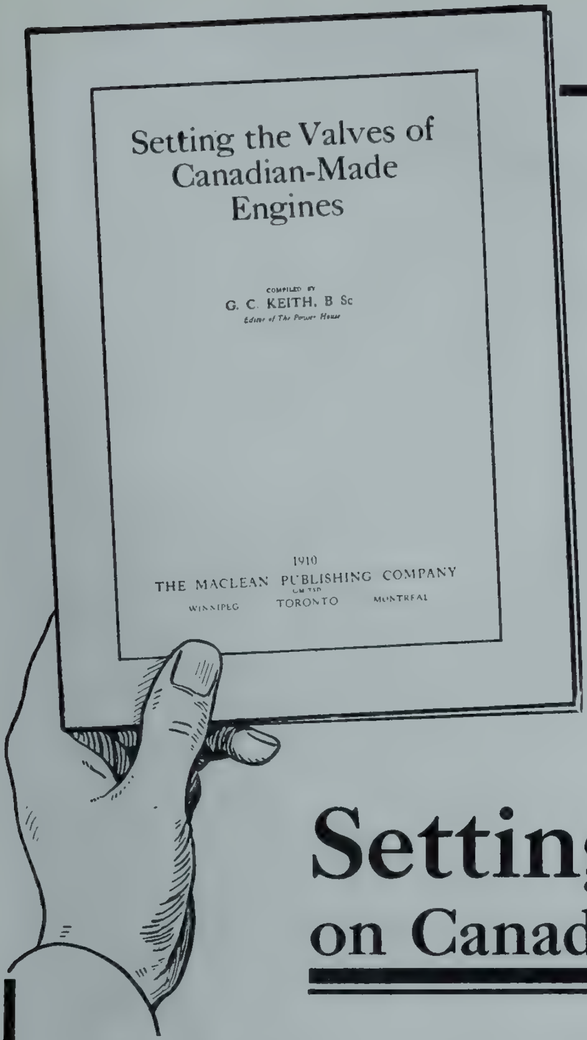

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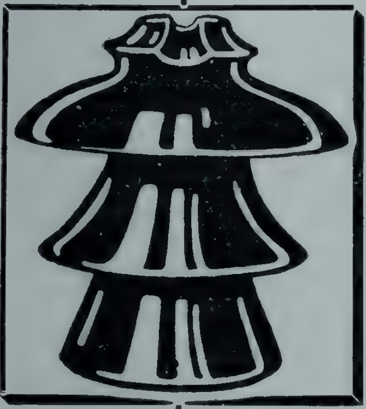

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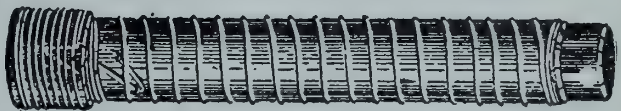

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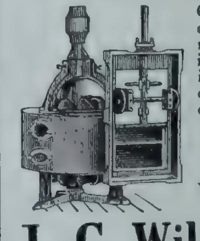

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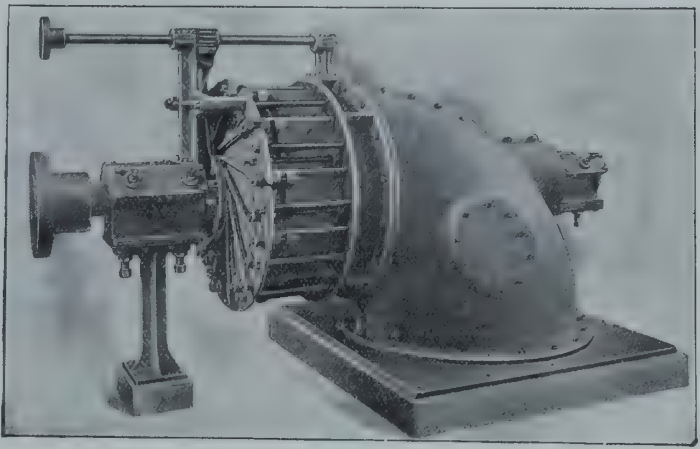

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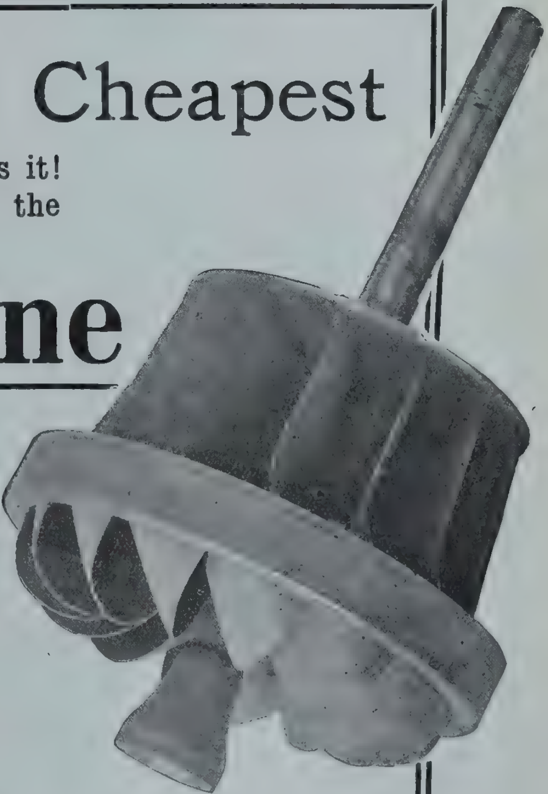

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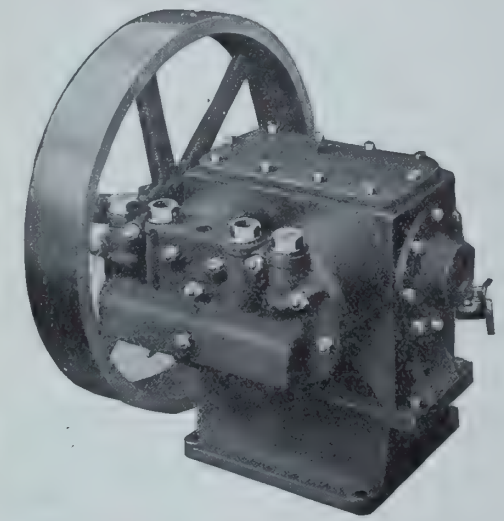

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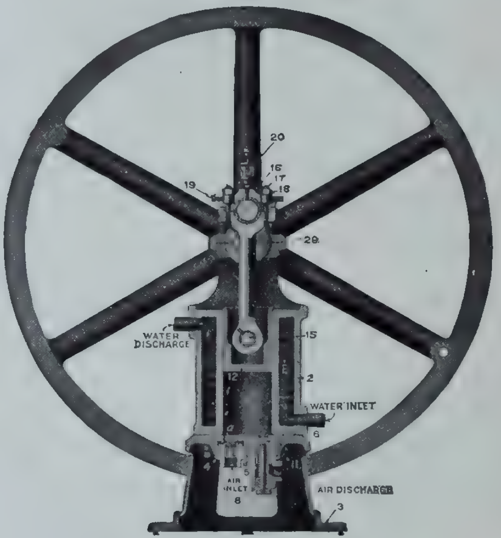

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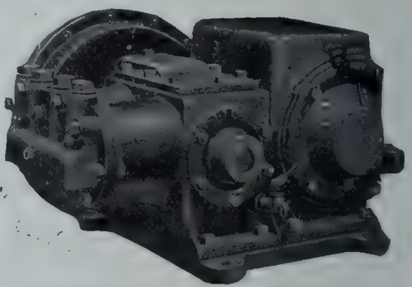

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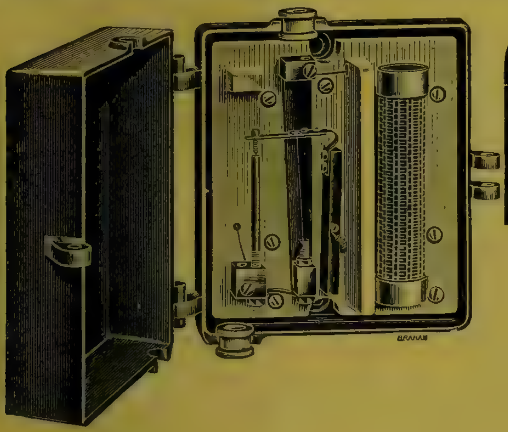

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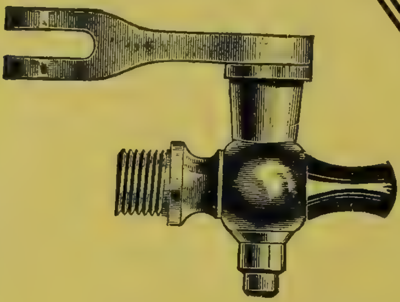

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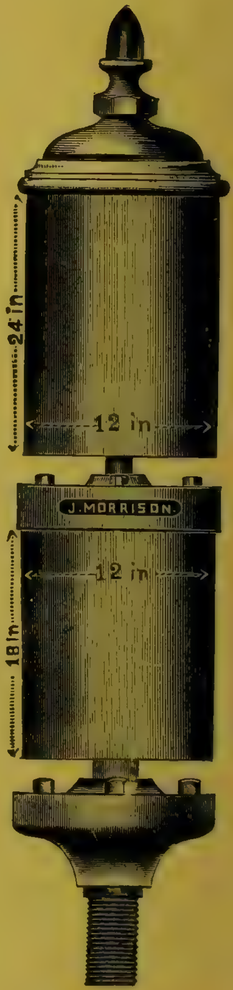

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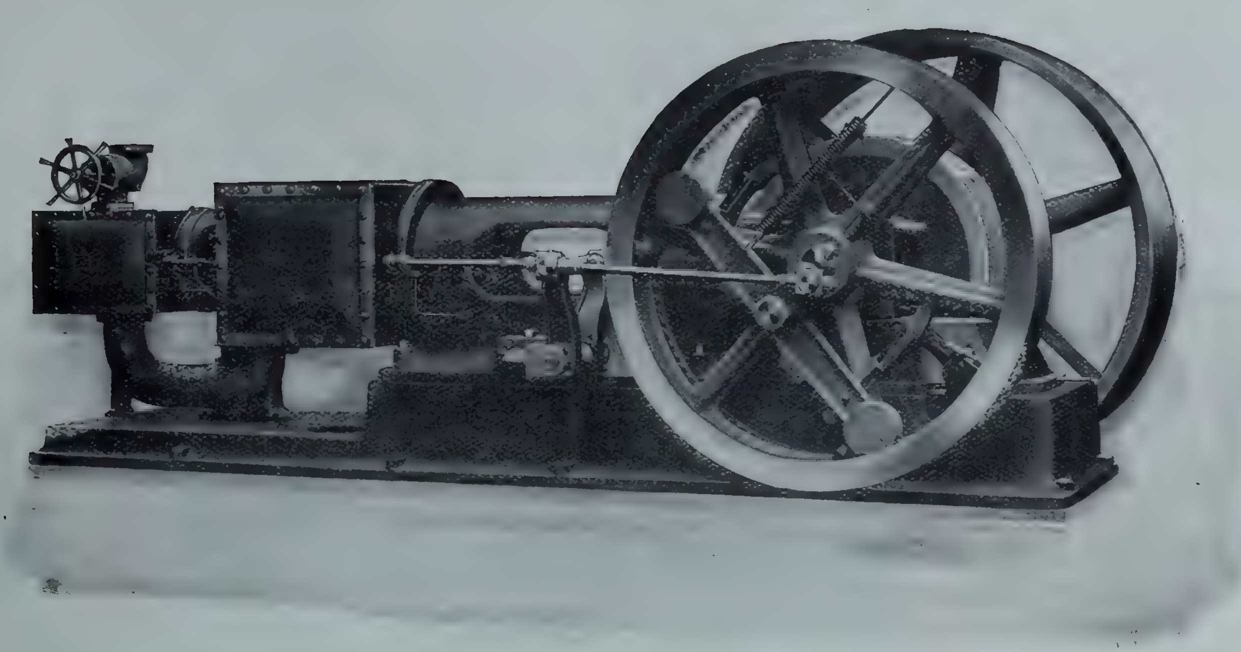

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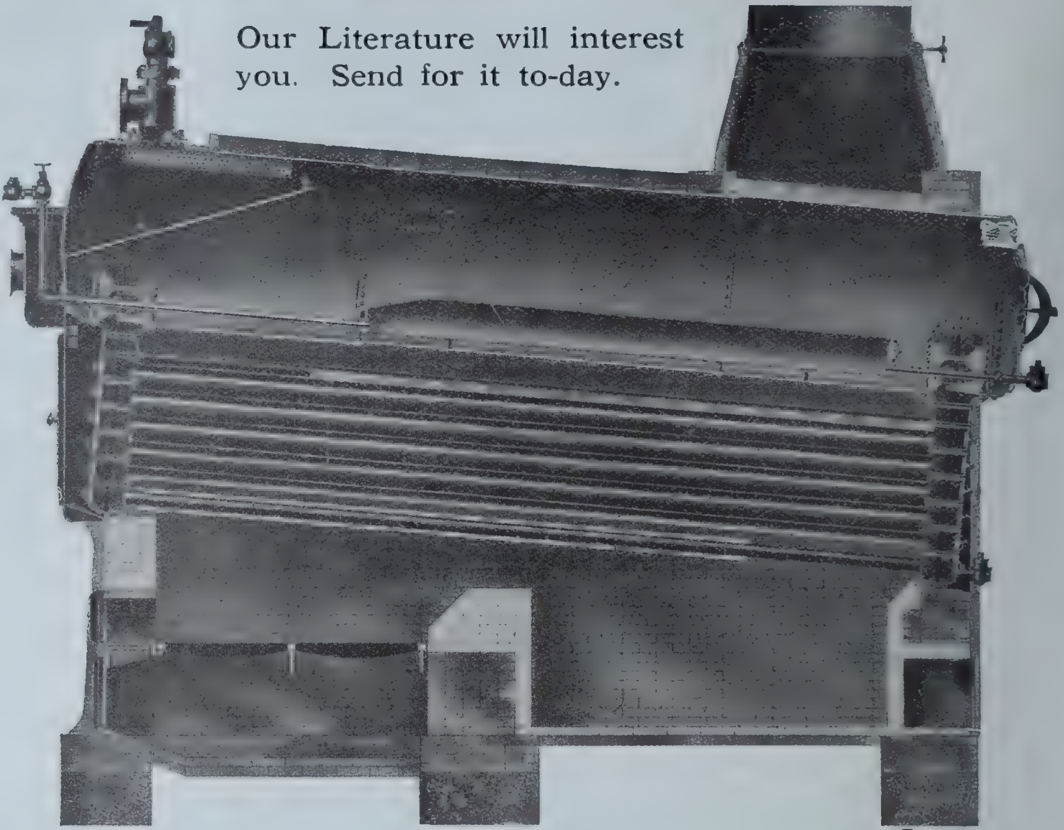

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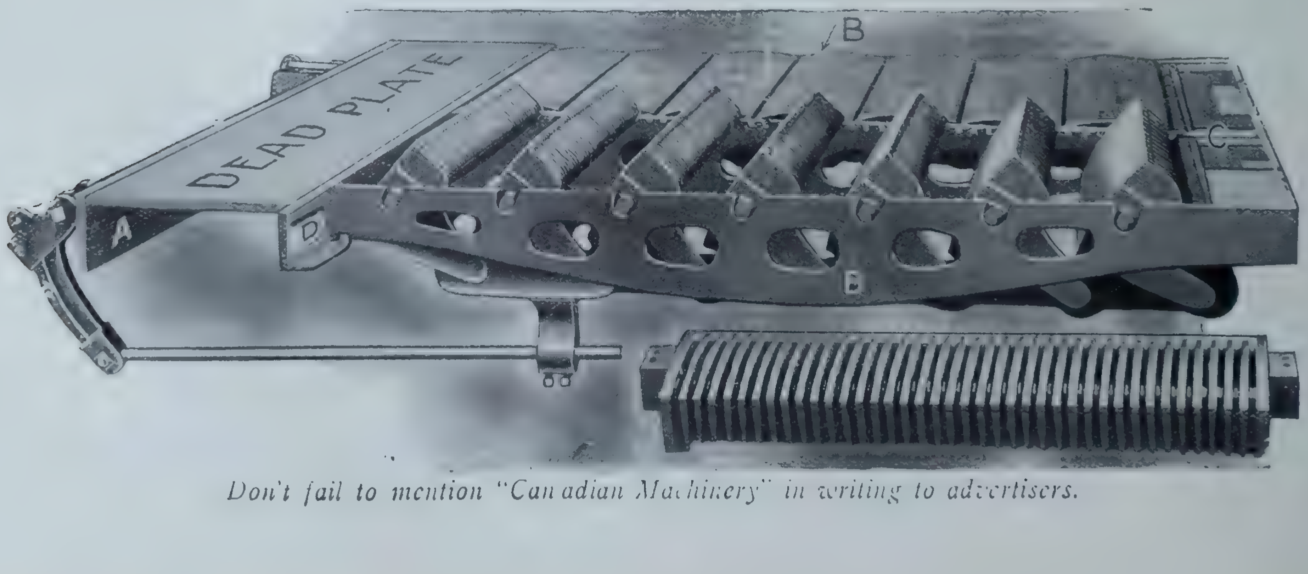

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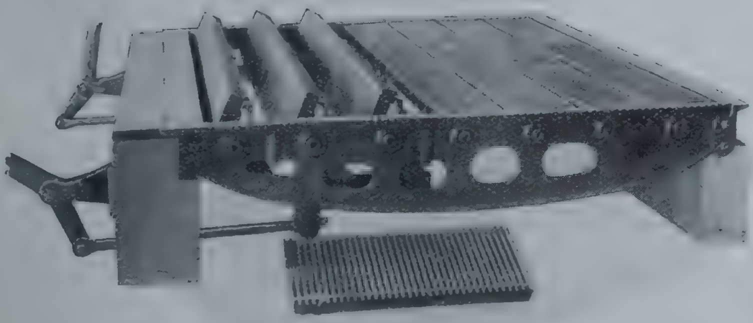
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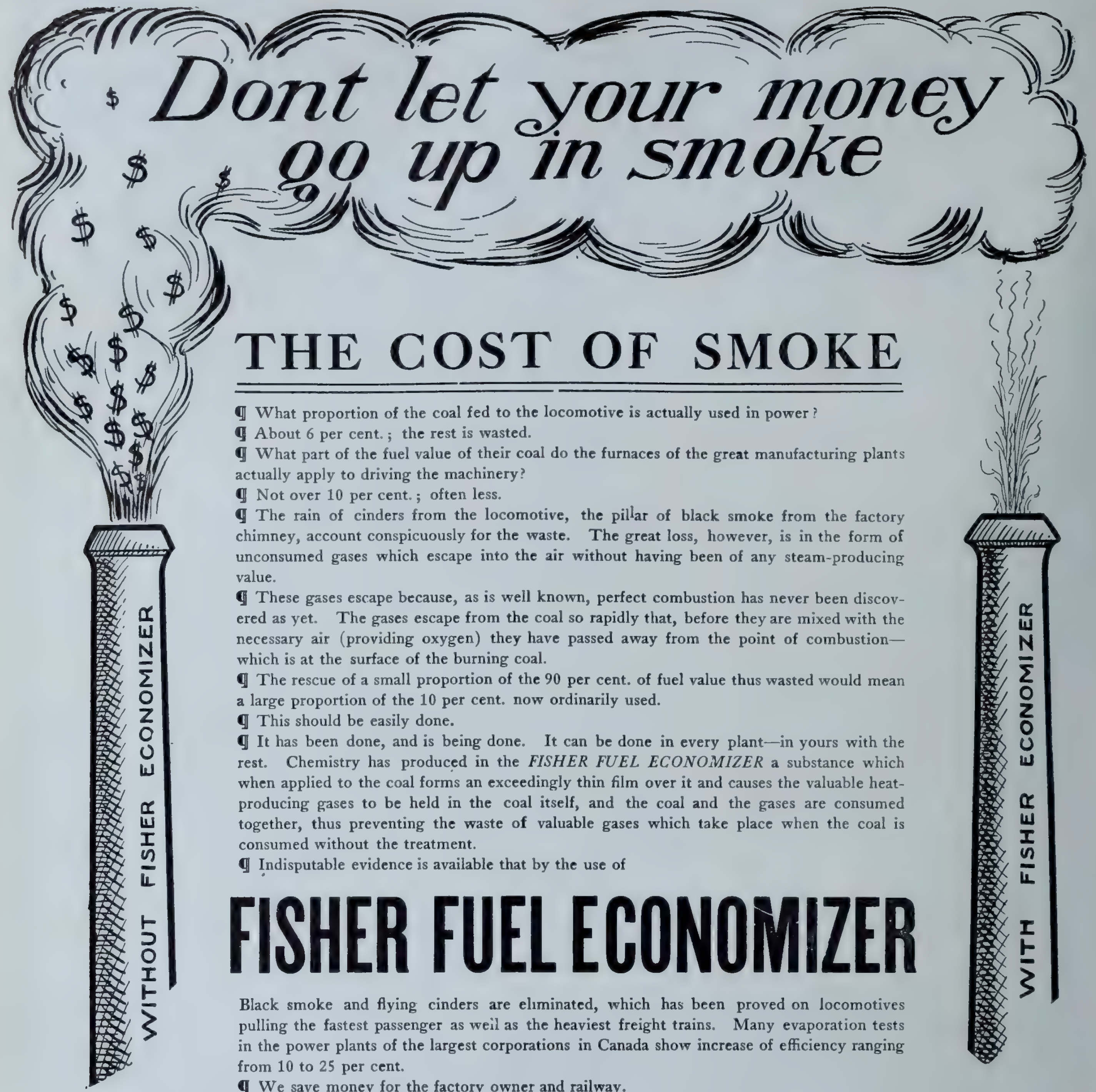

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Black smoke and flying cinders are eliminated, which has been proved on locomotives pulling the fastest passenger as well as the heaviest freight trains. Many evaporation tests in the power plants of the largest corporations in Canada show increase of efficiency ranging from 10 to 25 per cent.

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¶ We save the fireman much hard and dirty work.

¶ We save the black smoke which pollutes the air.

¶ We reduce your ashes and clinkers half.

¶ We increase and maintain steam to a degree which is impossible without the economizer.

¶ We keep your boiler tubes and grate bars clean, reducing expense of upkeep.

Let Us Prove It to You. Write To-day for Information

Phone Main 2390

Fisher Fuel Economizer Limited

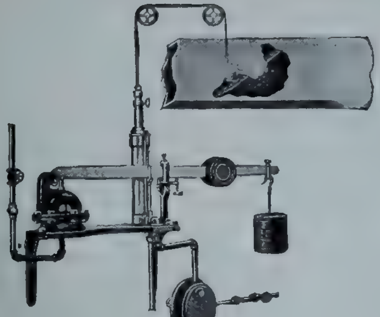
Head Office, 74 Bay St., Toronto, Ont.

MONTREAL
Gerald Rowe, 187 McGill Street
Phone Main 811

OTTAWA
569 O'Connor Street
Phone 4494

WINNIPEG
310 McGreevy Block
Phone Main 2750

The advertiser would like to know where you saw his advertisement—tell him.

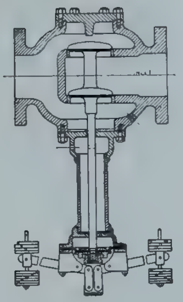


Lawrence Damper Regulator

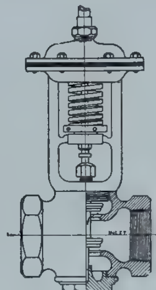
WATTS REGULATORS

are sold on trial and their service is

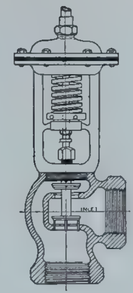
Guaranteed



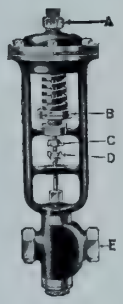
Lever Reducing Valve



Spring Reducing Valve



Pump Regulator



Fan Engine Regulator

Embodying, as they do, principles of correct design and accurate workmanship, these specialties are worth considering when in need of such. They will not fail at crucial moments, but continuously perform positive service. Get prices anyway, if only for sake of comparison.

Made by

Watts Regulator Co., Lawrence, Mass.

Sold in Canada by

Power Economies, Limited, 9 St. Nicholas Street **Montreal**

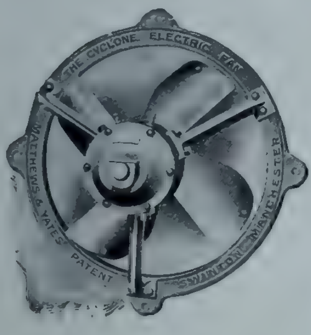
CYCLONE FANS

Embody Thirty Years' Experience in the

Design, Construction and Application

for all purposes, and therefore

Cannot be Approached for Efficiency and All Round Satisfaction



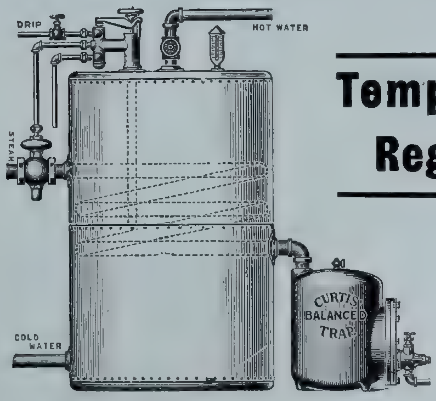
MATTHEWS & YATES Limited

Swinton, Manchester, Eng.

Agents for Canada, Bain & Mitchell
Y.M.C.A. Building, - Montreal

Curtis Engineering Specialties

Temperature Regulator



For controlling the temperature of hot water in hotels, hospitals, etc.

Send for circular and 1910 catalogue

JULIAN D'ESTE COMPANY

24 Canal Street, - Boston, Mass.

History Does Not Record Who Stole the Nag—

It merely tells us that a certain gentleman, in days gone by, waited until his horse was stolen before locking his stable door. But the point is:—Engineers who wait until they have to shut down the plant while they try to hammer scale out of boiler tubes are acting just the same way. The right way to tackle your scale problem is to inject into your boiler tubes some

Dearborn Boiler Compound

made up especially from an analysis of your feed water. That prevents scale formation---no hammering the tubes---no shut-downs, no wasted fuel or effort. We don't keep Dearborn Compound in stock---stock compound is strictly N.G. The only compound worth your while buying is a compound made up especially after a chemical analysis of your feed water has been made. *We make the analysis free.* Simply express us a gallon of your feed water, and we will, if you desire it, make up some compound that we absolutely guarantee to do the work.

Dearborn Drug & Chemical Works

ROBERT F. CARR, President

General Offices, Laboratory and Works, Chicago. **Eastern Offices, 299 Broadway, New York**

Dont Waste Time

or expense cleaning scaly tubes! any money spent in preventing scale is a far more profitable outlay than what it costs to remove the scale after it has formed. Prevent scale by using

INTERNATIONAL
BOILER COMPOUND

But we can't work in the dark; we must find out what your feed water contains before we can mix the compound that will eliminate the scale-forming salts. Express us one gallon of your feed water; we will analyse it *free of charge*, and will forward a TRIAL SAMPLE of our compound guaranteed to banish all your Scale Troubles.

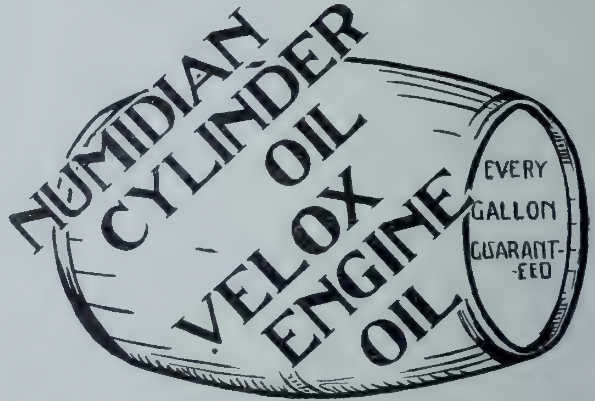
You can make money acting as our agent. Write for details of our offer.

Get in touch with us to-day.

International Boiler Compound Company

144-146 West Michigan St., Chicago, Ill., U.S.A.

The World's Famous Lubricating Oils



Quality **Quantity** **Price**

Freight allowed to destination

Sliptivity Machine Oil
Potato Scale Powder Boiler Cleanser
Oils and Grease of every description

C. C. Snowdon

Wholesale **P.O. Box 1384, Calgary**

ENGINES AND BOILERS

Single, Compound and Triple

Corliss Engines
for light and heavy duty.

Power Engines
Slide Valve, Rocking Valve

Marine Engines
Triple Expansion, Single Compound, Steeple Compound, Quadruple, Incline, and Tug Engines.

Pumping Engines
and Pumping Machinery.

Scotch Marine Boiler, 14 ft in diameter, built for the Richelieu and Ontario Co's. Steamer "Rapids Prince."

Return Tubular
Fitzgibbon
Locomotive
Scotch Dryback
Scotch Marine
Vertical
Submerged Tube

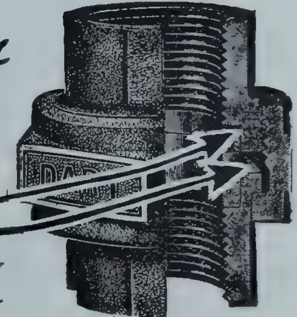
WATER-TUBE
Vertical and
Horizontal

Photos, Specifications and Prices Upon Request.

The JOHN INGLIS COMPANY, Limited

ENGINEERS AND BOILERMAKERS
14 STRACHAN AVENUE - - - - TORONTO, CANADA

A Bronze-to-Bronze Ball Joint that cannot leak



A joint that needs NO packing; that can be made QUICKLY whether pipes are IN or OUT of line; that will STAY ABSOLUTELY steam, air, water, oil and gas TIGHT.

This is a true description of

DART UNIONS

The only way you can start a leak on a Dart Union is to take a wrench and open it. Accidents NEVER "happen" with Dart Unions.

Your dealer sells Dart Unions—or should. Ask him.

Dart Union Co., Limited, 93-97 Niagara St. Toronto, Ont.

The advertiser would like to know where you saw his advertisement—tell him.

Canadian Association of Stationary Engineers

To the Stationary Engineer who is not a member of the C.A.S.E.:

Can a true, progressive engineer afford to be outside of our organization?

Remember that we will give methods of improvement to all our members desiring them.

If you are interested in such an association as ours and live where there are less than fifteen engineers located, send for our prospectus and a constitution and apply for admission to the nearest lodge. If you live in a town where there are fifteen or more engineers, get together and send in a written application for a charter.

The engineer of to-day, if he is a progressive one, is much interested in securing the passage of laws which compel the engineer to give evidence of his fitness to act as such.

W. A. CROCKETT, Executive Secy.

Mt. Hamilton, Ontario

OUR GUARANTEE IS UNMISTAKABLE

A packing that is not safe against leakage and blow-outs, that scores rather than smooths the rod, and that is always in need of attention is expensive if you get it for nothing.

PREMDURO
FLEXIBLE METALLIC
PACKING

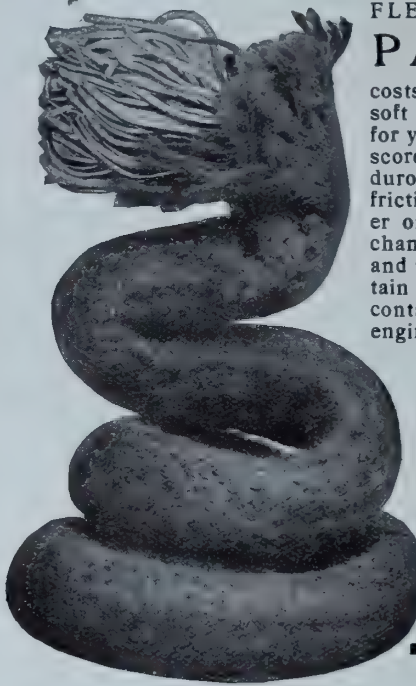
costs only a trifle more than soft packing, but it is good for years of service even on scored rods. With 'Premduro' there is no undue frictional heat, and no danger of the packing fusing or changing its composition, and it is guaranteed to maintain that easy steam-proof contact which enables an engine to do its best work.

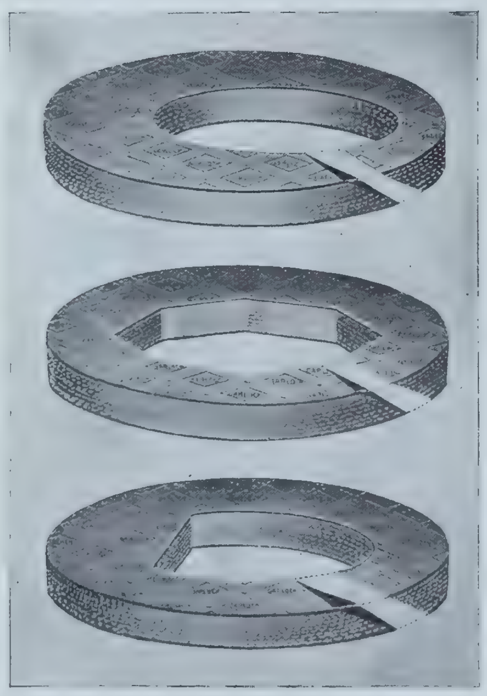
OUR GUARANTEE—Your money back if not absolutely and entirely satisfied. May we send you samples?

Premier Engineering & Manufacturing Co.
25 Broad St., NEW YORK

The International Supply Co. of Montreal, Eastern Agents

We are open to appoint agents for Ontario and Western Canada. Write for details of our proposition.

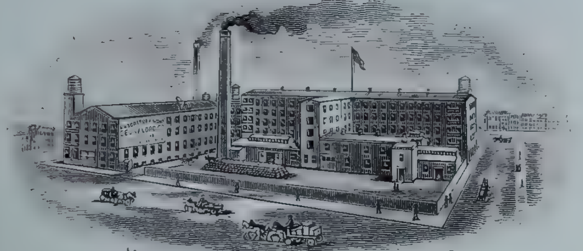




GARLOCK
STEAM HAMMER and ODD SHAPED
Ring Packing

Send us a template of any rings you require in this class. Being an exact fit, they give excellent satisfaction.

THE GARLOCK PACKING CO.
HAMILTON, ONTARIO



WORKS, DAUPHIN AND DELHI STS.

You Save We Profit

WHY NOT MAKE MONEY FOR EACH OTHER?

Have you considered that a good Compound will pay for itself by removing the scale in your boilers, and thus enabling them to steam better and quicker? This means a saving in your fuel and repair bills. If you are interested, mail us a sample of scale from your boiler and we will send you a Certificate of Analysis and a full report free of charge. We can refer you to plants in your territory which are using our chemicals continually. When you are in need why not give us a trial?

Geo. W. Lord Co.

2238 North Ninth Street
PHILADELPHIA, Pa.

Agencies in all other principal cities.

"SPECIAL"

The Only Packing You Need

to pack any type of engine or pump is P.P.P.

Built on the "give-and-take" principle of a compressible cushion and sliding wedges, the pressure P.P.P. exerts on a rod is in exact proportion to the requirement This means no friction during over 75% of the travel of the rod.

Scientific tests, conducted by the Dean of the Engineering Department of a leading American University, show that P.P.P. saved up to $590.00 a year in power cost on one engine,

DANIEL'S ROD PACKING P.P.P.

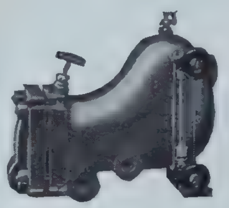
is made in three styles: "Regular," "Special" and "Special Marine." All styles are made in Coil, Spiral and Ring forms.

The claims made for P.P.P. are proved by the engineer's report in "The Story of Some Friction Tests," the only scientific treatise on packings published.

FREE Send your name and address with "Friction Book, 24—I" on a postal card, and we will mail you "The Story of Some Friction Tests," FREE. Do this TO-DAY.

Quaker City Rubber Co.

Philadelphia Chicago Pittsburg
New York, U.S.A.



McDANIEL IMPROVED STEAM TRAP

FOR HIGH OR LOW PRESSURE.

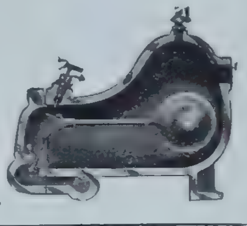
Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.

THE GARTH COMPANY
26 Craig St., MONTREAL, CAN.

IDEAL STEAM SEPARATOR & SUPPLY CO.
820 Euclid Ave., TORONTO, CAN.



Read what the

DUNHAM RADIATOR TRAP

will do for you when applied to the return ends of radiators. 1. Stop all pounding in pipes and radiators.
2. Do away with all air valves.
3. Put heat into every inch of every radiator in 30 minutes.
4. Keep entire system drained and prevent frost,
5. Effect a saving in fuel. **Write for illustrated circulars.**

C. A. DUNHAM & CO. 511 Continental Life Bldg. TORONTO

Geipel Expansion Steam Trap

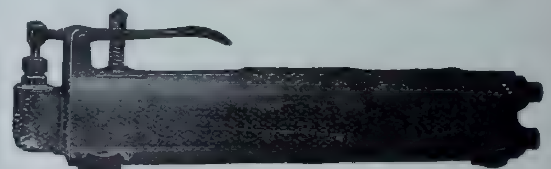
(PATENTED)

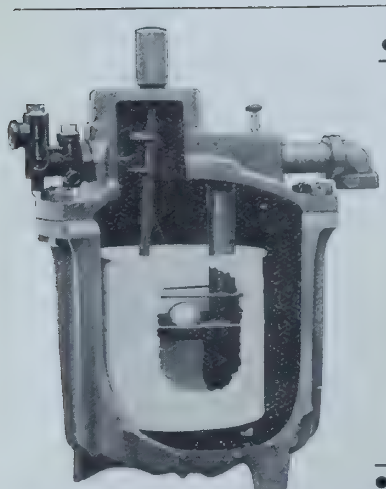
The Geipel Expansion Trap

Is a simple, practical trap, with few working parts to get out of order. It works equally well with either high or low pressure steam. Its simplicity and few working parts will commend this trap to every engineer. Send for Catalogue.

The
Canadian Fairbanks Co., Limited
Fairbanks Scales
Fairbanks-Morse Gas Engines
Safes and Vaults
Montreal Toronto St. John
Winnipeg Saskatoon
Vancouver Calgary

Geipel Expansion Trap





THE ALBANY
STEAM TRAP

Will solve the problem for you. Backed by over 40 years' trap experience. Get in touch with the makers:---

The Albany Steam Trap Co.
ALBANY, N.Y.

The Morehead Steam Trap
as a Dividend Payer

AMONG boiler room appliances there is none that possesses, to an equal degree, the fuel time, water and labor saving features of the

MOREHEAD RETURN STEAM TRAP AND BOILER FEED

A Morehead installation keeps the steam lines, separators, etc., free of air and condensation and returns the latter direct to the boiler at the temperature of the return and without the use of an expensive steam pump equipment, or injector.

A Morehead Trap requires but 10 per cent. of the steam consumed by the steam pump for performing the same work and requires little or no attention and practically no "up-keep."

The 'Morehead' is a silent but generous contributor to the Dividend Fund. Just ask the user of a Morehead Trap in your neighborhood. The purchaser is our best salesman.

Write to-day and ask for Trap Book and trial offer proposition.

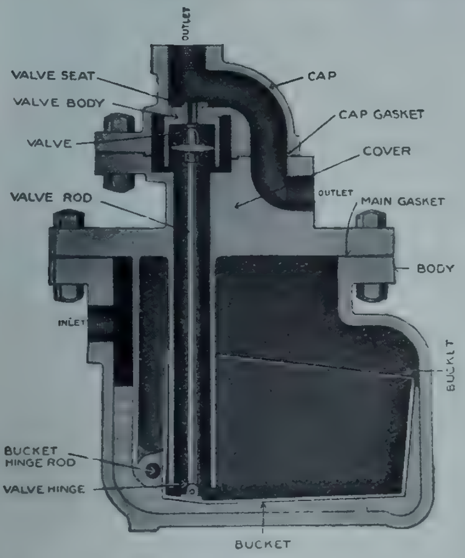
MOREHEAD MANUFACTURING CO.
DEPARTMENT "J"
DETROIT, MICHIGAN

Canadian Representatives: A. R. Williams Machinery Co., Toronto; W. H. Markle, Montreal; Park Bros., Chatham, Ont.

IS IT NOT THE TRUTH

That by actual experience we learn the real worth of a machine?

Registered
4/S
Trade Mark



The Strong, Carlisle & Hammond Co.
Cleveland, Ohio.

Right here is your opportunity to know just exactly what

STRONG STEAM TRAPS

will do in service without one cent of expense to you.

Our offer:—We will ship one or more Strong Traps on 60 days' free trial. If you don't find them all we say they are, send them back at our expense.

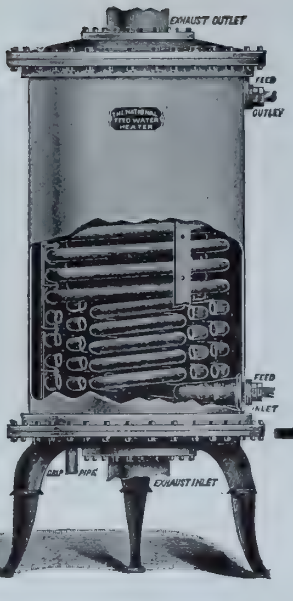
Strong Traps Save Every Puff of Steam.

SEND FOR CATALOG

The Canadian Fairbanks Co.
Sole Representatives for Canada

Montreal *Toronto* *St. John, N.B.*
Winnipeg *Calgary* *Vancouver*

Thousands of Horse Power in use in Canada



The NATIONAL FEED WATER HEATER

has proved itself to be the most simple, practical and efficient heater on the market.

From one to fourteen coils of seamless drawn brass or copper tubing are encased in a cast-iron or steel shell to which exhaust steam is admitted, heating the water passing through the tubing.

There are no inside joints to leak, no leaky straight tubes, no back pressure, no contact of the water with shell or iron.

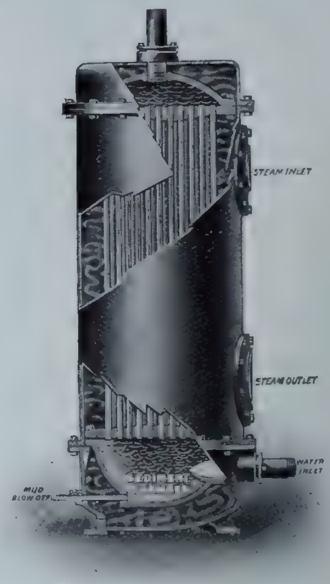
We have an interesting booklet on Feed Water Heating which is yours for the asking. Send for your copy TO-DAY.

The National Pipe Bending Company
91 Lloyd Street
NEW HAVEN, CONN., U.S.A.

Mackie Patent Heaters

"Made in Canada."

The tube portion of this heater is not attached to the shell. Allowance for free expansion and contraction makes it the most durable heater on the market.



Goulds Pump Company

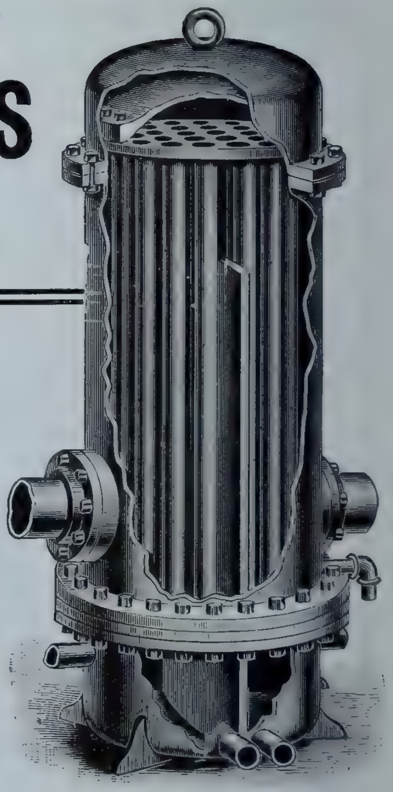
National Trust Bldg.,
TORONTO

Coristine Building,
MONTREAL

Investigate the merits of the

JACOBS

Feed Water HEATER



The "Jacobs" will positively make use of the waste steam from your exhaust to the very best advantage; heating your feed-water to the boiling point.

It is easily the simplest, best constructed and most effective apparatus of its kind ever introduced. Fully guaranteed.

Send for descriptive circular.

Chas. J. Jacobs & Co.
42 Oliver Street, BOSTON, Mass.

Are You Using Your Exhaust Steam?

There is power in it which we can harness for you!
By means of the

OTIS Tubular Feed Water Heater Oil Separator and Purifier

You can heat your Feed Water to the boiling point without any back pressure.

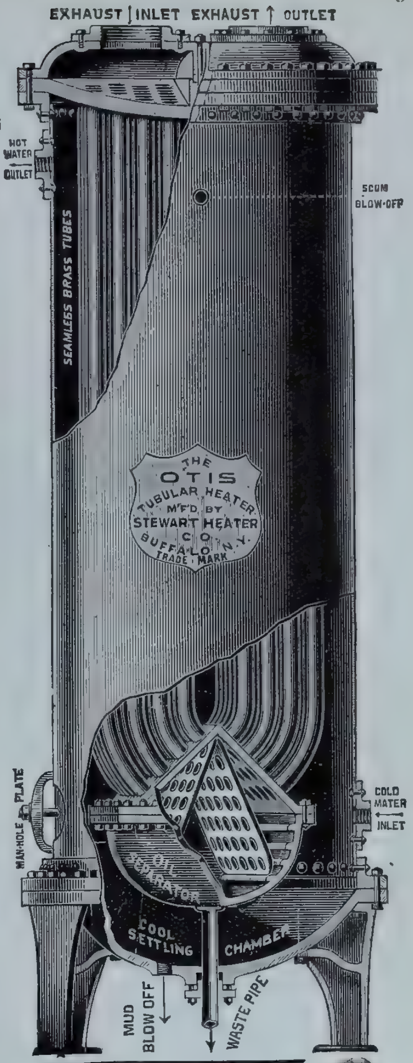
The OTIS will return the water of condensation from the heating system to the boiler without the additional expense of an eliminator, and will, moreover, extract the oil from the exhaust, so that the steam, after passing through the heater, can be used for other heating purposes.

We pay all costs of a trial if the OTIS doesn't do all we claim for it.

Write to-day for Catalogue and Prices

The Stewart Heater Company

189 Norfolk Avenue Buffalo, N.Y., U.S.A.



Boiler Room Trouble Savers

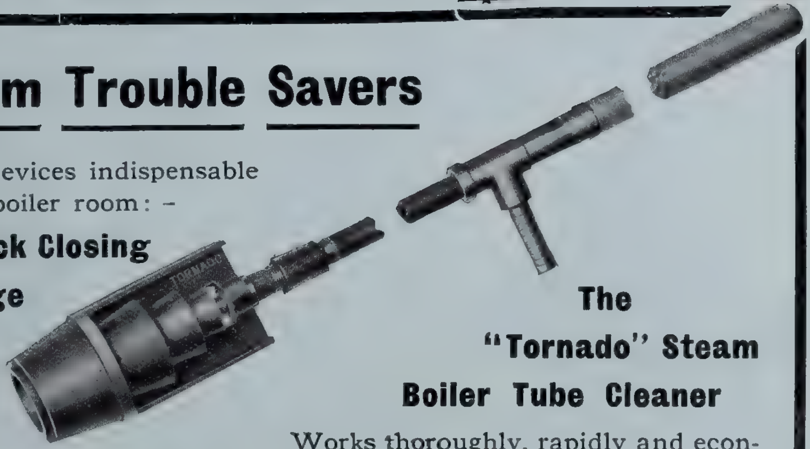
Here are three devices indispensable in every boiler room: –

The "P.B.H." Quick Closing Water Gauge

(Cut on Left)

Insures against burns and scalds. A pull shuts off steam and water in case of a broken glass.

Sent on Trial



The "Tornado" Steam Boiler Tube Cleaner

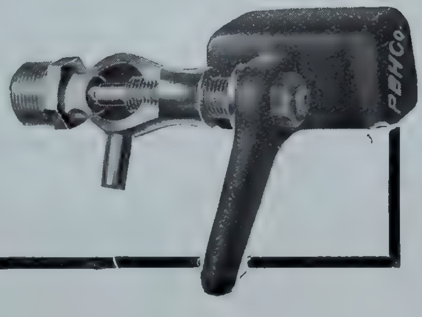
Works thoroughly, rapidly and economically. Carries no moisture to wet soot, and blows through the longest tubes.

Sent on Trial

The "P.B.H." Quick Opening, Self Closing Gauge Cock (Cut Below)

Is guaranteed leakless for years. Simple, efficient, economical and quickly repaired.

Sent on Trial



THE PAUL B. HUYETTE CO., Inc.

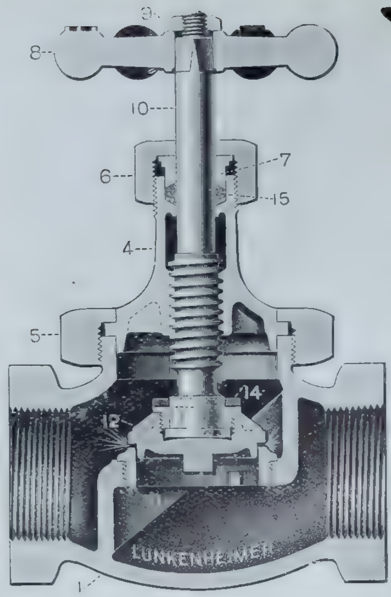
1414 Betz Bldgs., Philadelphia, Pa., U.S.A.

WRITE FOR CATALOGUE

Selling Agents for Western Ontario and North-West: Canadian Steam Boiler Equipment Co., 186 Queen St. E., Toronto

Selling Agents for Province of Quebec and Eastern Ontario: Peiler & MacKenzie, 52 St. James St., Montreal, Canada

Selling Agents for Maritime Provinces and Newfoundland: Peiler, MacKenzie & Lodge, Moncton, N.B.



LUNKENHEIMER RENEWO VALVES

ARE POSITIVELY THE MOST DURABLE AND PRACTICAL MADE

THE SEATING SURFACES CAN BE RE-GROUND and ALL PARTS SUBJECTED TO WEAR CAN BE RENEWED, including the **DISC** and **SEAT.** The **SEAT** is **SELF-CLEANSING** and is made of a hard, close-grained nickel.

The bronze used contains a high percentage of copper and tin. The improved construction of the disc **PRESERVES THE SEATING FACES** and **PREVENTS WATER HAMMER.**

LUNKENHEIMER "RENEWO" GLOBE, ANGLE and **CROSS VALVES** are guaranteed for 200 pounds working pressure, and are made in sizes ranging from ¼ to 3 inches inclusive.

"Most supply houses sell them—yours CAN—if they DONT or WONT, tell US."

Write for catalogue

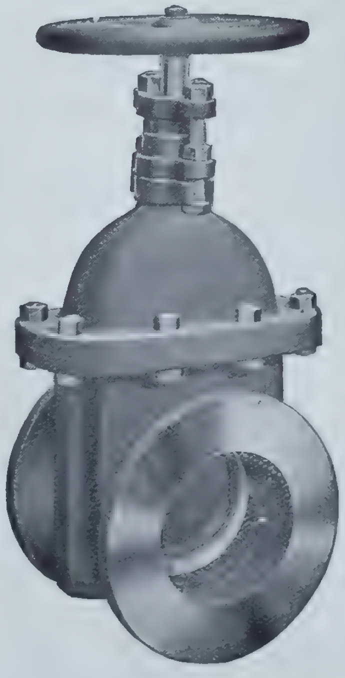
THE LUNKENHEIMER COMPANY

Largest Manufacturers of high-grade Engineering Specialties in the World

General Offices and Works

CINCINNATI, OHIO, U.S.A.

NEW YORK —BRANCHES— CHICAGO
64-68 Fulton Street 32 Dearborn St., Cor. Lake
LONDON, S.E., 35 Great Dover Street.



Kerr Gate Valves

are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

Write for our Catalog of High Grade Brass and Iron Valves.

The
Kerr Engine Co., Limited
Valve Manufacturers
WALKERVILLE - ONTARIO

1,200,000 IN USE

Detroit Lubricators have been preferred for the greatest industrial plants in the world because of their workmanship and durability, efficiency and economy.

Detroit Lubricators

Nine-tenths of the engine builders in America specify genuine Detroit Lubricators, because they believe in them and customers demand them.

A Detroit Lubricator will save you money, cause your engine to run better, prolong its life, and materially decrease your oil bill. Write to-day for Catalogue A-58 and full information.

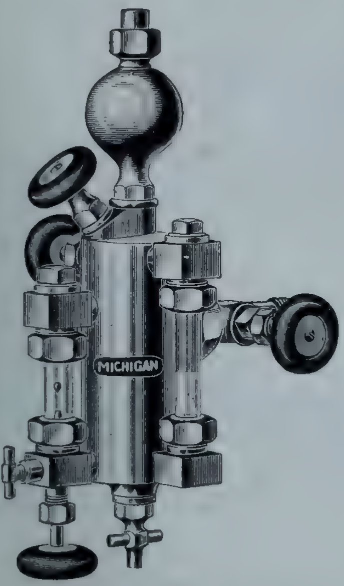
DETROIT LUBRICATOR COMPANY.

DETROIT, U.S.A.

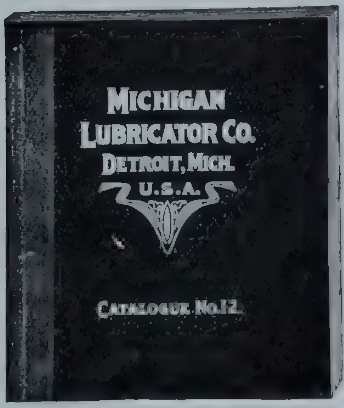
Largest Manufacturers of Lubricating Devices in the World.

MICHIGAN

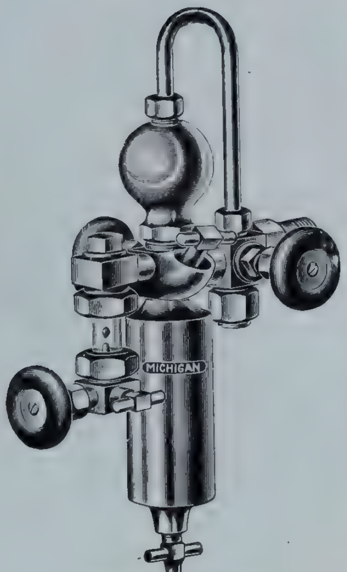
Illustrated catalog mailed to you free



Improved Double Connection,


MICHIGAN
LUBRICATOR Co.
DETROIT, MICH.
U.S.A.
CATALOGUE No.12.

WRITE TO-DAY



Improved Single Connection.

MICHIGAN LUBRICATOR CO.

DETROIT, MICH.

The Richardson-Phenix Co.
MILWAUKEE.

Appliances For Lubrication

Richardson Automatic Oil Pumps
Oil Filtering Systems
Phenix Force Feed Oil Pumps
Gang Oilers
Sight Feeds Plunger Pumps.
Union-Cinch Fittings

The Richardson-Phenix Co.
MILWAUKEE, WIS.

Eastern Sales Office:--	Western Sales Office:--
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New York City.	Chicago.
J. Wm. Peterson, Mngr.	J. S. Ward, Mngr.

Successors to
Sight Feed Oil Pump Co., Milwaukee, Wis. The Phenix Lubricator Co., Chicago, Ill.

Canadian Agents:
Williams & Wilson, Montreal.
A. R. Williams Machinery Co., Toronto, Winnipeg, Vancouver.

We Want You to Know

That We Manufacture

STEAM BOILERS OF ALL KINDS,
STRUCTURAL IRON AND STEEL,
HAND POWER CRANES,
PENSTOCKS, RIVETTED PIPE,
IRON and STEEL TANKS of all kinds and sizes, including water, oil or transformer tanks.
STEEL FIRE ESCAPES
STEEL LADDERS AND STAIRWAYS
AIR RESERVOIRS.

We are experts in the Oxygen-Acetylene process of welding, which we use largely in Tank work.

We would like you ***to give us a chance*** to supply your requirements in any of these lines.

International Marine Signal Co. Limited
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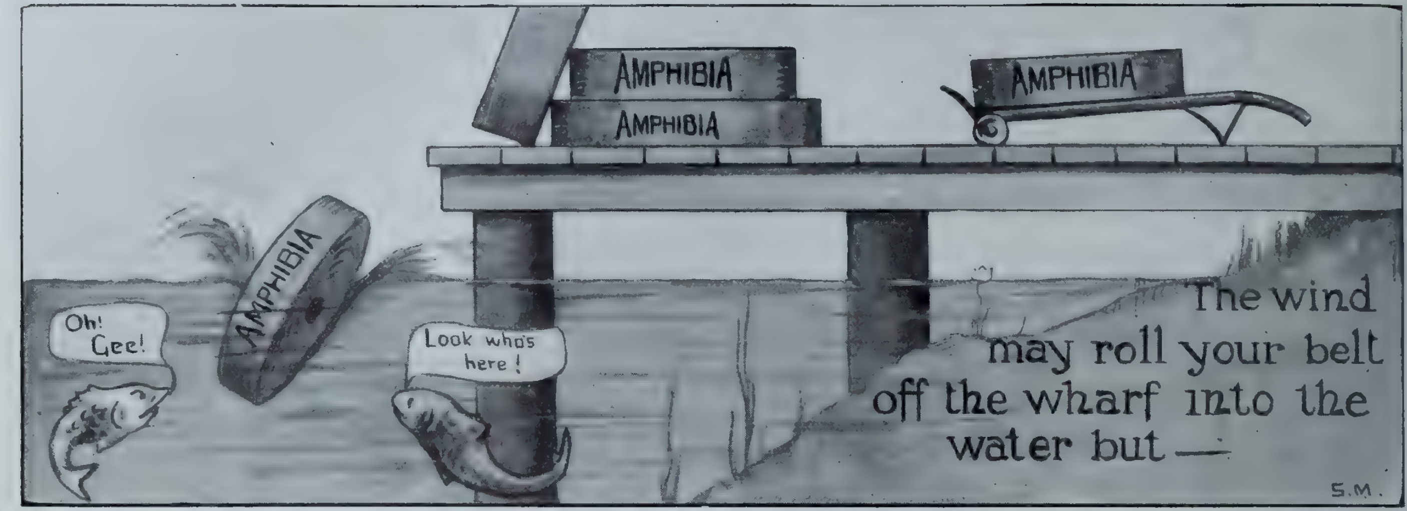
Neither Water nor Steam can Injure

"AMPHIBIA" Leather Belting


AMPHIBIA
AMPHIBIA
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Oh! Gee!
Look who's here!
The wind may roll your belt off the wharf into the water but—
S.M.

that wouldn't injure "Amphibia" (waterproof) even a little bit. The leather, the joints, the plies are made impervious to any degree of moisture or wetness by our improved process of waterproofing.

"Amphibia" is absolutely waterproof. It is giving first class service to-day in some of the wettest plants in Canada. Saw Mills, Steam Laundries, Cement Plants, Pulp Mills and other places where moisture is plentiful will find "Amphibia" the very best belting to use.

Recommend "Amphibia" for your plant and your purchasing agent will credit you with saving a lot of the firm's money. Try it.

"Amphibia" is made only by

Sadler & Haworth

ESTABLISHED 1876

For 34 years the makers of the best Belts

MONTREAL, 511 William St.
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☛ TO INSURE SATISFACTION—STATE WHERE BELT IS TO RUN ☚

PHILIPS'
PRESSED
STEEL PULLEYS
ARE
PRE-EMINENT
IN
POWER
TRANSMISSION

And Possess all the Great Points Desired by the Modern Engineer

Lightness and Strength
Perfect Balance
Rigid Construction
Smooth Face for Belt Contact
Sure Grip on Shaft
Economy in Load on Shafting
Interchangeable Bushings

THE PULLEY FOR PAPER, PULP AND LUMBER MILLS

EXTENSIVE STOCK VARIOUS SIZES WRITE FOR LISTS

D. K. McLAREN, Limited

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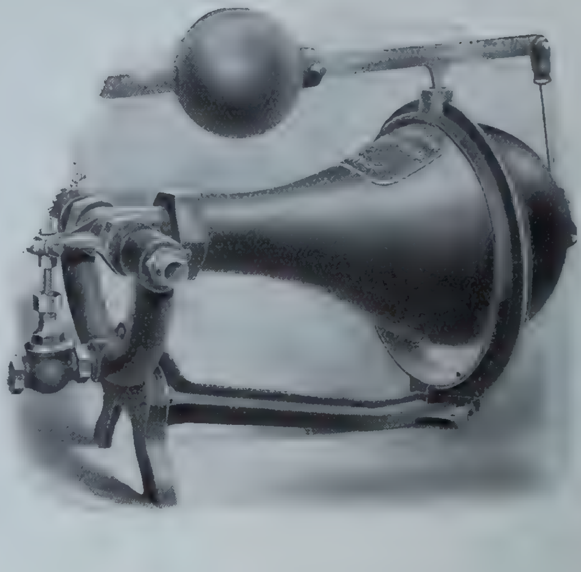
Wherever Steam is Used

for heating, boiling or drying, both money and trouble can be saved every day by installing

"BUNDY" Steam Traps



In the great majority of cases a Bundy Trap will save enough fuel in less than one year to pay entirely for its cost and installation.

The best argument in favor of the "Bundy" Steam Trap is the enormous number of them in use to-day in all parts of the world. The operating principle is gravity. And it is so simple, yet so strong in construction, that they never fail to give a long period of satisfactory service.

We are prepared to give expert advice for the application of "Bundy" Traps under any circumstances.

WRITE US CONCERNING YOUR CONDENSATION AND BOILER FEEDING PROBLEMS

FEED OUTLET
REILLY MULTICOIL FEED WATER HEATER

HEAT YOUR FEED WATER WITH THE

"REILLY" Multicoil Heater

It is the simplest and most effective heater known.

A series of seamless drawn copper coils, through which the feed water is constantly circulating, are connected to headers by screwed, ground union joints, and enclosed in a shell into which exhaust steam is fed. Feed water attains to within 2 degrees of the temperature of the exhaust steam. No other heater is so efficient, size for size.

The price is interesting.

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Ashton "Pop" Safety Valves

are always entirely reliable. They are perfectly automatic in action and there is nothing in their construction or design that makes them liable to get out of order. A very valuable feature of these well-known valves is the "pop" chamber, which certainly does prevent steam frm being wasted. We have an interesting catalog describing the entire line, that will interest you greatly.

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PEILER & LODGE, MONCTON, N.B.

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The Panama Canal will be completed on schedule time. Great engineers and the best machinery and materials are being used to accomplish that end, and Magnolia metal is doing its share in this great work.

ISTHMIAN CANAL COMMISSION
DEPARTMENT OF CONSTRUCTION AND ENGINEERING
MECHANICAL DIVISION
OFFICE OF SUPERINTENDENT OF MOTIVE POWER AND MACHINERY, CULEBRA, CANAL ZONE

BALBOA, C.Z., August 9th, 1910

MAGNOLIA METAL CO.

Dear Sirs:—Your Practical Engineer Pocket Book came duly to hand, after a long delay, two weeks ago, Please accept my thanks for same.

I suppose there is more Magnolia Metal being used on the machinery bearings in this "Big Ditch" than on any other large job in the world, and it is without doubt giving all us engineers entire satisfaction. Me for Magnolia at all and every time. Again thanking you. Very truly,

H. C. MARTELL.

SPECIAL OFFER

PRACTICAL ENGINEERS' POCKET BOOK

Containing 680 pages, treating on over 2,000 Engineering and Mechanical subjects brought up-to-date. We offer this valuable reference work at 40c, postage prepaid.

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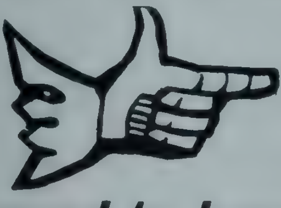


Pleased to have your order

The Canada Metal Co., Limited,
31 William Street, Toronto

Dear Sir,—In replying to your enquiry of recent date as to how we found our Stearn Bearings on our Twin Screw Steamer Cayuga, which were babbitted with your Imperial Genuine Bearing Metal, beg to say that the bearing is under water, and after two seasons' hard service there being no perceptible wear. As you know we substituted your Imperial Genuine Babbitt to replace the lignum vitae bearings which were a source of trouble and expense, and since the change these particular bearings gave us no concern. Yours truly,

Geo. M. Arnold,
Chief Engineer N.N. Co.

The Canada Metal Co., Limited, Toronto

Two Clean Boilers Cost Less For Fuel than One Dirty One

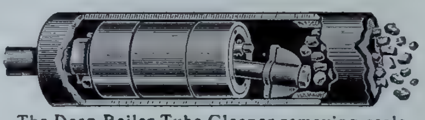
Scale not only plays havoc with your boilers, but makes big holes in your coal pile.
An engineer wrote us the other day he was saving over $4 a week on coal through the use of

The Dean Boiler Tube Cleaner

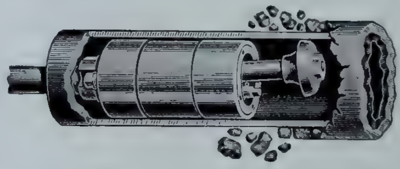
In other words, scale was eating up that many dollars' worth of coal before he used the Dean.
We can save YOU money and we'd like a chance to show you how.
Write for booklet No. 130 and our free trial offer.

The WM. B. PIERCE CO.

330 Washington Street, Buffalo, N.Y.
Montreal Office: 230 Coristine Building, Montreal



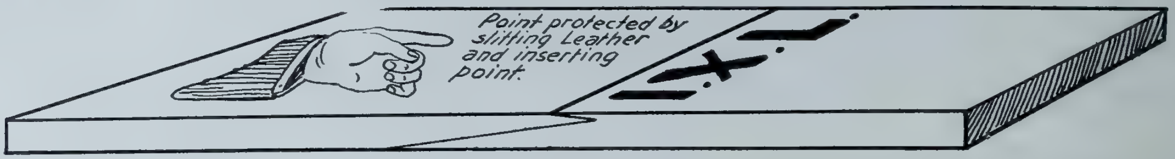
The Dean Boiler Tube Cleaner removing scale from the tube of a water tube boiler.



The Dean Boiler Tube Cleaner removing scale from the tube of a return tubular boiler.

THE "I.X.L." SPLICE

"THE BELTING SPLICE THAT WILL NEVER COME OPEN"



The great trouble with *any* belting—no matter how good the leather—that is joined up with the ordinary splice, is the fact that the splices come open, causing loss and delay. J. D. McArthur's Leather Belting made with the "I.X.L." SPLICE, as shown in this cut, *cannot* come open at the splices. Note the protected point, outside point running same direction as pulley.

J. D. McArthur's Leather Belting is made from Prime British Oak-Tanned Leather, from Close-Trimmed Backs exclusively.

Write for our complete price list.

J. D. McARTHUR & CO., Brockville, Ontario

Stock at Toronto Branch 639 King St. East; J. E. Stephenson & Co., Agents

SAFE AND ECONOMICAL

You can keep the water in your boiler at exactly the right level for absolute safety and economical fuel consumption by installing a

RELIANCE

SAFETY WATER COLUMN

This device is very well made and finished, and can be absolutely relied upon to give constant, satisfactory service.

We also make:
- Reliance Steam Traps
- Reliance Lever Water Gauges
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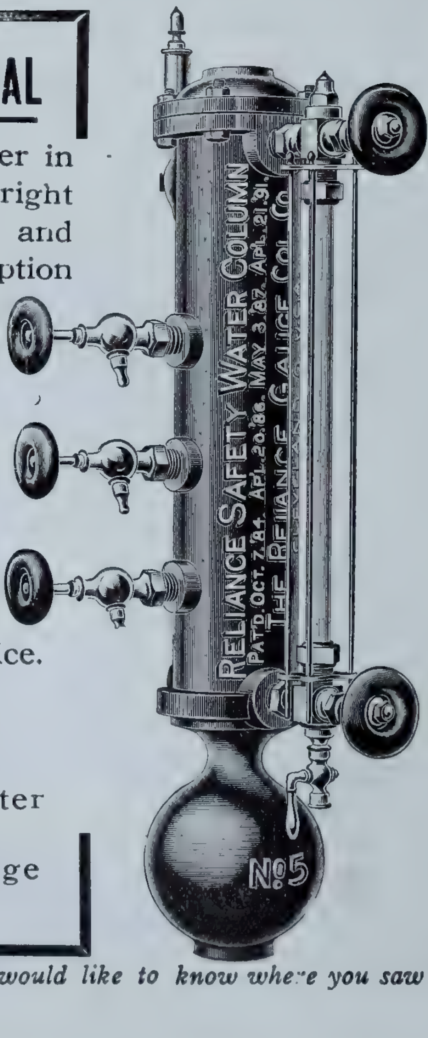
RELIANCE SAFETY WATER COLUMN
PAT'D OCT. 7.'84. APL.20.'86. MAY 3.'87. APL.21.'91.
THE RELIANCE GAUGE COL. CO.
No5

Whenever the water in the boiler falls below or rises above the right level, the "RELIANCE" sounds an alarm whistle, thus giving warning of danger to engine from too much water, or of explosion from too little water. The valves are placed well above the high-water level, and positively cannot clog. We also make a "Reliance" Column for low water alarm only.

Illustrated Catalogue free on request; send for a copy to-day.

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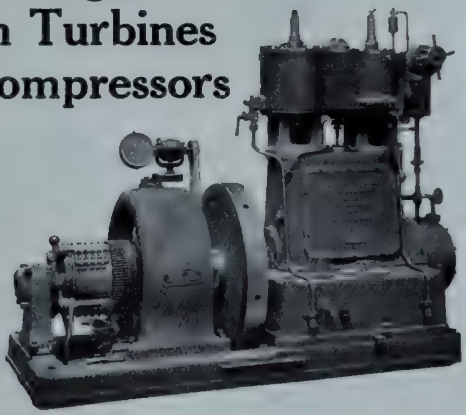
Belliss Engines
Steam Turbines
Air Compressors



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BELLISS & MORCOM, Limited

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The quiet, smooth running of every Belliss machines is a constant surprise to Engineers.

The low coal and oil bill is a continual pleasure to the proprietor.

The invariably satisfied customer constitutes an ever growing asset of the

CANADIAN AGENTS

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BRASS-FITTED THROUGHOUT

The BURNHAM will not short stroke—and for this reason it is the most suitable pump for HOT WATER SERVICE.

You can always depend on the BURNHAM for handling the condensation from Heating Apparatus, Dryers, etc., etc. Standard sizes in stock.

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Mine Hoisting Engine

Cylinders, 22 inches diameter; stroke, 42 inches; about 900 horse power; double drums 8 feet diameter, 5 feet wide.

Corliss Valves, steam actuated clutches and brakes. The reversing gear, throttle, brake and other levers are grouped at a central platform.

This engine was completed within the last few months and is thoroughly modern. Write for drawings, specifications and photographs.

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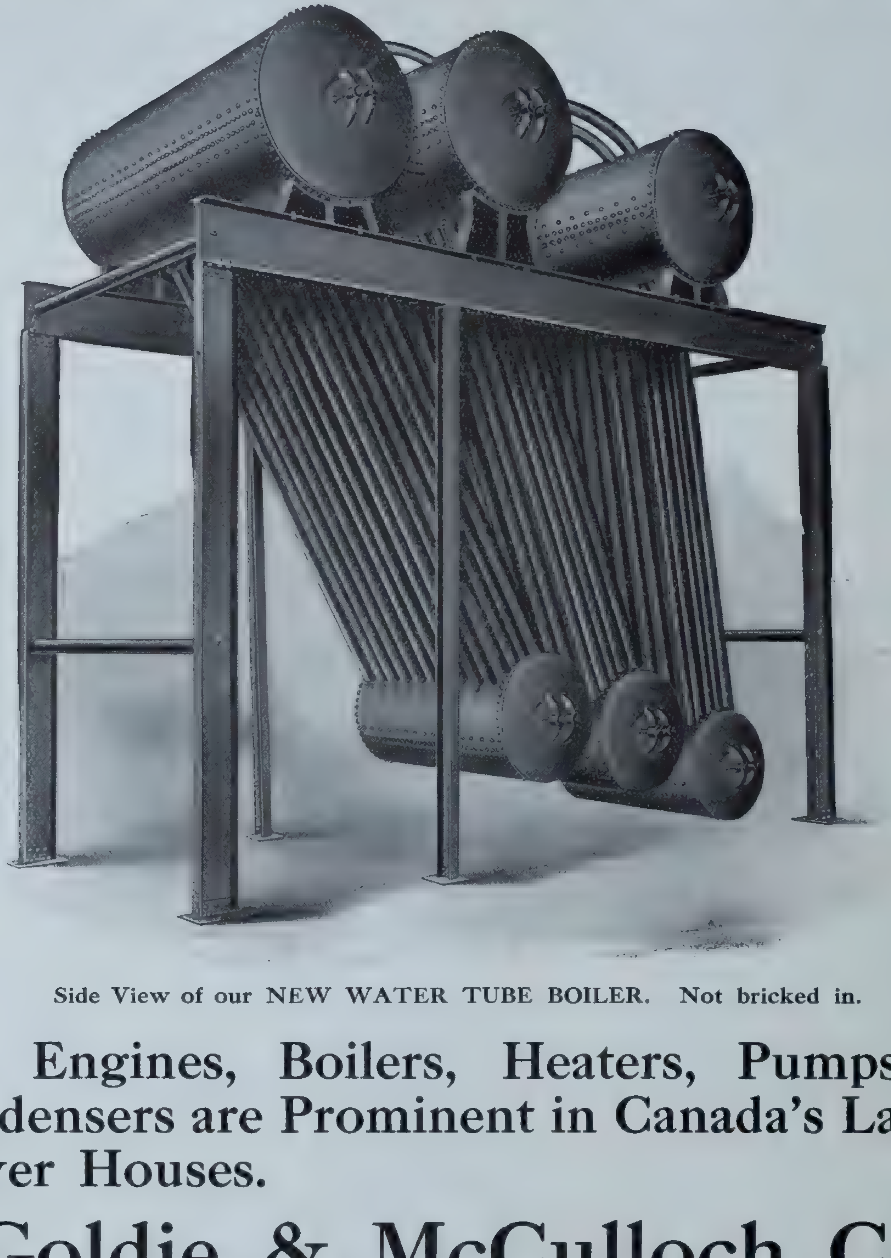
Return Tubular, Horizontal Marine, Vertical and Portable Boilers, with or without Wheels



Side View of our NEW WATER TUBE BOILER. Not bricked in.

Our Engines, Boilers, Heaters, Pumps and Condensers are Prominent in Canada's Largest Power Houses.

The Goldie & McCulloch Co., Ltd.

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WE MAKE Wheelock Engines, Corliss Engines, Ideal Engines, Piston Valve Saw Mill Engines, Gas Engines and Producers, Boilers, Heaters, Steam and Power Pumps, Condensers, Flour Mill Machinery, Oatmeal Mill Machinery, Wood-Working Machinery, Transmission and Elevating Machinery, Safes, Vaults and Vault Doors.

Ask for Catalogues, Prices and All Information.

Plant of the Cobalt Power Company at Hound Chutes

Description, with Illustration, of a Large Modern Power Generating Station Supplying Energy to a Large Number of Cobalt's Mines.

A number of water powers have been harnessed in the vicinity of Cobalt, one of the more recent being the one at Hound Chutes on the Montreal River, about six miles from Cobalt. At this point the river is 160 ft. wide, with a fall of about 16 or 17 feet. Here the main dam, which would raise the level of the water so that it could be deflected through a canal running to the power house, was built. It was twenty-seven feet high with a log slide arranged so that the lumbering operations would not be interfered with in the spring. By means of the dam, the water was raised high enough to give a total head of thirty-five feet at the power house.

The canal into which the water is diverted is sixty feet wide, and 1,400 feet long. This job, necessitated the removal of 22,000 cubic yards of earth and 10,000 yards of rock. At the head of the canal, a gate was built between two very large concrete piers, so that the water flowing down the canal could be diverted back into the river bed should anything arise at the power house that required attention and which could not be reached while the canal was full of water.

Power House, Cobalt Power Co.

At the lower end of the canal is the power house. The building is 132 feet long by 32 feet wide, and from the bottom of the wheel pit to the roof it measures 82 feet. It is built of steel and concrete throughout; 140 tons of steel and 6,000 cubic yards of concrete being used in its construction. It was designed for developing 4,000 horse power with four separate units. It is fully equipped with all modern facilities in handling and caring for large machines, including an over-head traveling crane.

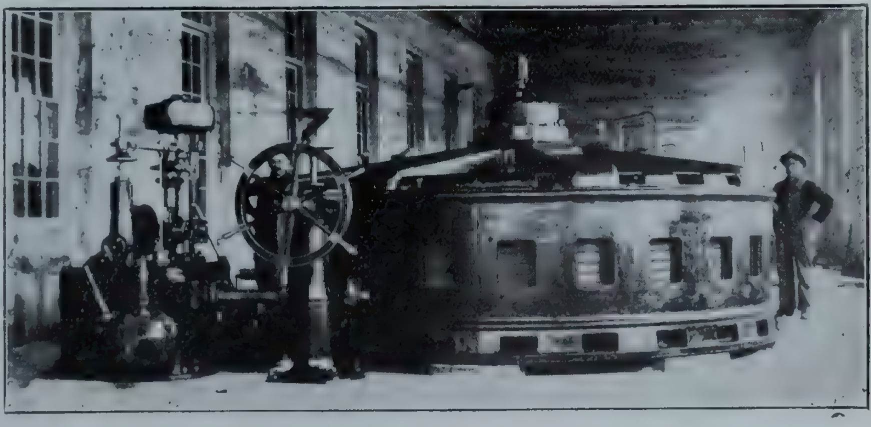
The complete hydraulic layout including the power house building was designed by A. Vonaesch, M.E., chief engineer of William Kennedy & Sons, Owen Sound, which firm supplied all the hydraulic apparatus. The electrical plans including the power house equipment, transmission lines and sub-stations, were supplied by Kilmer, Pullen & Burnham, Toronto. The contract for the construction of the concrete dam to replace the temporary timber dam was awarded to E. Smith, recent superintendent of the Cobalt Power Co.

Hound Chutes on Montreal River

Generators.

The generators were manufactured by the General Electric Co., of Sweden, and purchased through their Canadian agents, Kilmer, Pullen & Burnham, which firm is also responsible for their installation. The order for this apparatus was placed in March, 1909, and the plant was completed and in operation within a year. Since that date their operation has been uninterrupted.

The generator units, three in number, are of the vertical shaft type, 875 kilowatt capacity, 3 phase, 60 cycle, 11,000 volts operating at a speed of 150 r.p.m. The diameter of a generator is 14 feet over-all. A unique feature of these machines is the method in which the weight of the revolving field is supported by a specially designed ball thrust bearing mounted upon the top of the generator frame in a position which is easily accessible for inspection and repair. The machines are also supplied with two guide bearings, one on each side of the revolving field in order to take up any side thrust. Means are supplied for adjusting the bearings so as to maintain a uniform air gap. Lubrication is supplied on the gravity system from a reservoir on top of the generator, the oil passing through the bearings and being caught in a receptacle beneath the machines, after which it is filtered and passed again into the storage system. In view of the fact that the transmission line was of a moderate length, it was deemed advisable not to use transformers, but to


A Governor and Generator, Cobalt Power Co.

wind the machines for the line voltage, and by this means making it easy to supply power over a fairly wide range of territory. In one of the line drawings shows a section through one of the main units from which may be clearly seen the arrangement of thrust and guide bearings on both generator and turbine. Another line drawing shows a section through the main units as well as exciter units, from which it will be seen that the arrangement for the small exciter units is on exactly the same principle as for the A. C. generators.

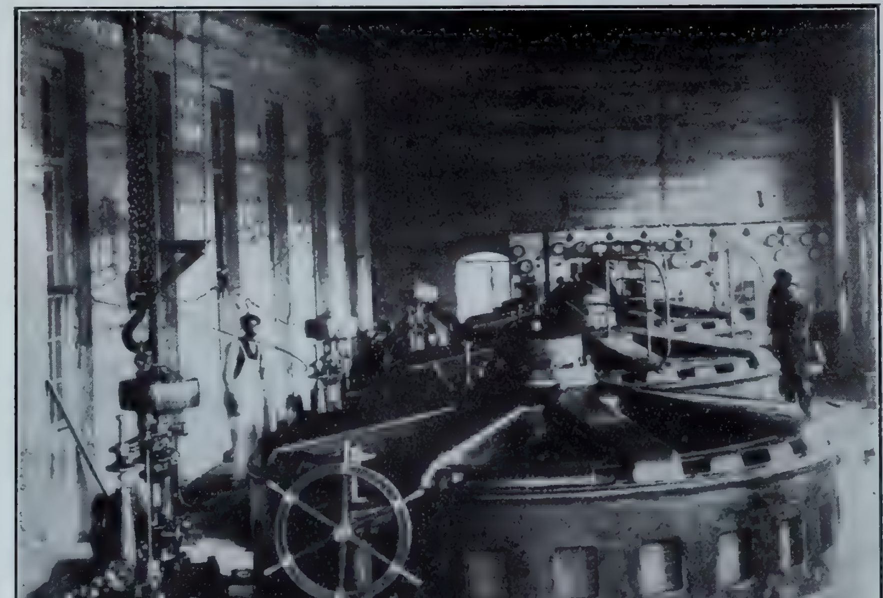
Exciters.

The exciters, two in number, are each of 60 kilowatt capacity operating at a speed of 500 r.p.m. These machines are also manufactured by the General Electric Mfg. Co., of Sweden, and are of the vertical shaft type, the revolving armature being supported in a similar manner to the large generators. In this case, however, guide bearings are also of the ball bearing type. Lubrication is supplied in the same manner as for the larger machines. Each exciter unit is of sufficient capacity to operate four A. C. generators as well as supplying current for lighting the power house. The A. C. generators are connected to the switchboard by means of three core lead covered cable carried in a duct way below the main generator floor. All field leads and exciter cables, etc., are of lead covered cable.

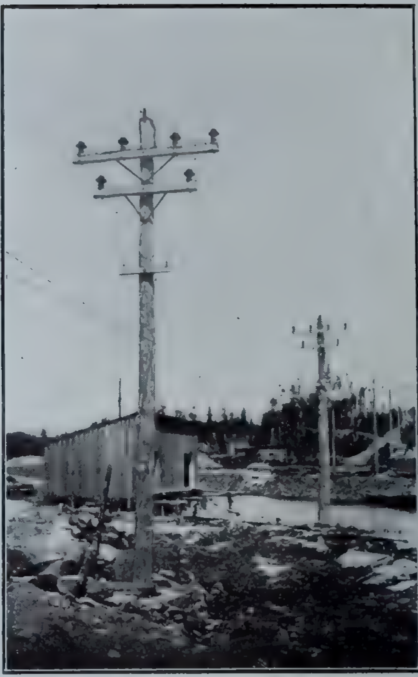
Switchboard.

The switchboard, which is located at one end of the building, is mounted in a space left in the wall dividing the main power house floor from the high tension chamber, and consists of eight panels of grey Italian marble, made up as follows: One exciter panel, four generator panels, one totalizing panel, two line panels. The synchronizer, bus-bar voltmeter and machine voltmeter are mounted on a swinging panel fastened at one end of the switchboard. Behind the board are mounted on the angle iron framework all machine rheostats, relays and fuses.

The generator switches, line switches, series and potential transformers and disconnecting switches are mounted in the high tension chamber in reinforced concrete cells. These cells are placed about 10 feet back of the switchboard, the switches being of the remote manual control type and the operating rods being carried under the floor. Each generator switch is placed in a separate compartment, the outgoing leads passing through a slab to the current transformers immediately above; then through the concrete barrier to knife disconnecting switches, from thence to the bus-bars. Great care has been taken to isolate the individual apparatus for each unit, also the bus-bars, so in the event of failure of an oil switch or similar trouble, the same is altogether localized and the possibility of an arc spreading over the whole high tension system is completely eliminated. The generator switches as well as the line switches are equipped with time limit relays operated from the exciter bus-bars. The main bus-bars are carried in concrete cells arranged on the upper part of the high tension chamber extending the full width of the same. The outgoing leads are taken from the main bus-bars through two oil switches, from there through the ceiling of the high tension chamber to the choke coils and line disconnecting switches.



Cobalt Power Company's Plant at Hound Chutes.



Main Line Showing Type of Construction.

The totalizing panel is equipped with one polyphase recording wattmeter of the curve drawing type from which double load on the station is recorded. There is also supplied on the same panel one recording voltmeter of the curve drawing type.

Lightning Arresters.

On the second floor of the high tension chamber, the lighting arrester equipment is installed. Two sets are supplied for each line, one set being of the well-known G. E. multiple gap type, the other the horn gap. The horn gap arresters consist of two gaps in series equipped with shunt and series water resistance. The past summer has been conspicuous for very severe electrical storms, but no interruption of the service has been occasioned from this cause. Disconnecting switches are supplied for each set of lightning arresters by means of which they may be isolated from the line for inspection and cleaning purposes. The lines leave the building through the end wall by means of wall insulators manufactured by the Locke Insulator Company. Immediately outside the exit the strain is taken up by a heavy wrought iron structure on which are mounted standard type line insulators.

Great care has been taken in laying out the equipment in order to obtain a simple reliable installation and one which may be easily operated.

Turbines.

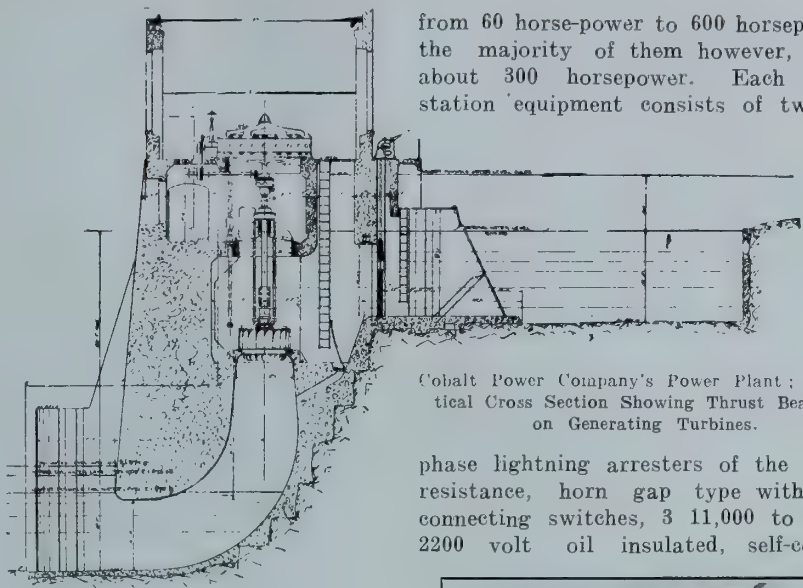
The turbines, seen in cross section in line drawings were supplied by the William Kennedy & Sons, Owen Sound. They are Francis type, vertical shaft, 1,335 horsepower on a 32.5 foot head, at 150 revolutions per minute, and are direct connected to the generators. Each turbine chamber is supplied with a gate 10 feet by 15 feet, with by pass and gate lifting apparatus, as well as two stop log checks. Each generator turbine is supplied with a concrete draft tube designed to give 20-foot drop. The exciter turbines have steel draft tubes for about the same head. Each turbine unit is regulated by the Italian governor, manufactured by Riva & Co., Milano, a design which is giving excellent satisfaction.

Transmission Lines.

The main transmission line is a straight run from the power house to Cobalt and is about seven (7) miles long. Where it passes through timbered country a right-of-way 125 feet wide has been cut and cleared. This line consists of two 3-phase lines of No. 3 0 stranded copper. The poles are of cedar, unusually straight and large, averaging 30 to 35 feet in length with 8 inch tops and placed about 85 feet apart. The insulators are mounted on the cross arms with malleable iron saddle pins, and are designed for a working pressure of 27,000 volts.

From this main line feeders are taken off at different points to supply the out-lying mines. Some of these feeders are about five to six miles long. The feeders are of No. 2 hard drawn copper, and in each case consist of two 3-phase lines.

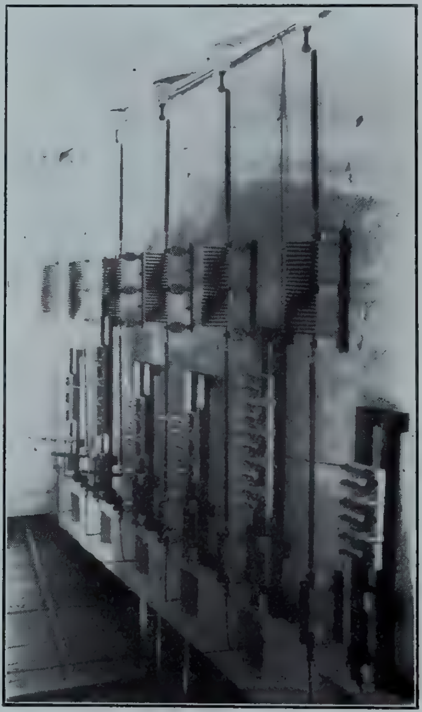
The power house is lighted by means of enclosed arc lamps, supported from wrought iron brackets fastened to the side wall, the current supplied from the exciter bus-bars. The power house is equipped with one 20 ton traveling crane arranged to serve the whole building from end to end. This has proved a valuable feature in the installation work, and is of sufficient capacity to handle the heaviest lift required.


Cobalt Power Company's Power Plant ; a Vertical Cross Section Showing Thrust Bearings on Generating Turbines.

The telephone system between the power house and the central office in Cobalt is carried on the main pole line and below the lower cross arm. The line is transposed every third pole and no trouble has been caused from induction, the system being clear and distinct at all times.

Sub-stations.

The first of October, 1909, the complete sub-station equipment was placed with Kilmer, Pullen & Burnham. This contract consisted of 19 complete sub-station equipments varying in capacity from 60 horse-power to 600 horsepower, the majority of them however, being about 300 horsepower. Each sub-station equipment consists of two 3-phase lightning arresters of the water resistance, horn gap type with disconnecting switches, 3 11,000 to 550—2200 volt oil insulated, self-cooled, step-down transformers, one switchboard panel for the control of the transformer secondaries, having mounted on it one polyphase integrating watt meter, one 3-pole, automatic oil circuit breaker.


Lightning Arresters, Cobalt Power Co.

At each mine supplied by the Cobalt Power Company, a small sub-station is built outside the mill to install this equipment. The switching arrangement of the sub-stations is such that any sub-station can be placed on either one of the transmission lines without interfering in any way with the service. This has been found a valuable feature in the event of making line repairs and the possibility of isolating certain portions of the load.

The construction work was carried on under very severe and difficult conditions owing to the fact that the bulk of it was done during the winter, and

Busbar and High Tension Oil Switch Compartment, Cobalt Power Co.

great credit is due to the various contractors for the manner in which these difficulties were met and overcome. The plant was put in commercial operation early in April, 1910, and since that time has been in continual operation, supplying power without any interruption to the service. The first unit was started up in a temporary structure before the power house was completed, a temporary switchboard being provided in one of the chambers off the thrust deck. The various customers of the Cobalt Power Co. were supplied by these means for a period of six weeks. At the end of that time the power house building was finished and erection commenced on the second two units and switchboard.

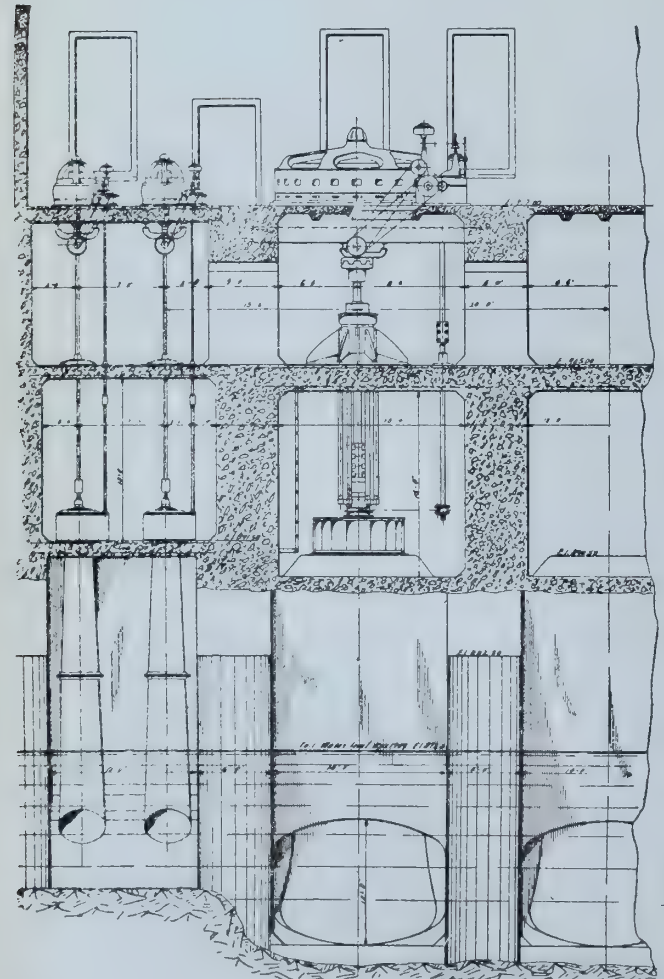
It is interesting to note that out of the thirteen mills in the Cobalt camp, eight are running on power furnished by the Cobalt Power Co. These eight are: Colonial, King Edward, Buffalo, Coniagas, Trethewey, Temiskaming, Nipissing and Cobalt Central. These mines have shipped one-third of the total tonnage for the year.

The selling rates are: A flat rate of $50 per horse power per annum, based upon the average of peak loads during fixed intervals; or a meter rate of $1 a horse power per month based upon the capacity of the motors installed, plus a rate per kilowatt hour on the same capacity, which varies from three cents per K. W. H. for 25 h.p. to one cent on anything from 500 h.p. up. Discounts are also given the customers, depending upon the load factor in each month.

EXPIRING SUBSCRIPTIONS

A large number of subscriptions expire with the October issue of The Power House. In order that no one shall miss the *Annual Boiler Feed Water Number*, the expiring subscriptions should be renewed at once.

THE POWER HOUSE,
143-149 *University Ave,*
Toronto.



Cobalt Power Company's Power Plant; a Vertical Longitudinal Section Showing Small Exciters.

SOUVENIR PAPER KNIFE

An unique paper knife has been designed by the manufacturers of Shelby Steel Tubing. As it is made from a piece of the tubing it is a practical demonstration of how this material can be used.

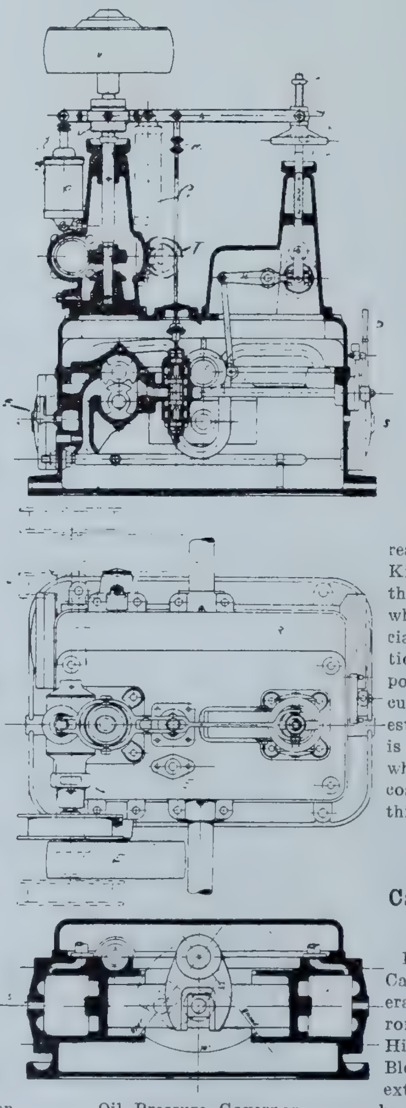
Jno. Millen & Sons, 321 St. James St., Montreal, the Canadian agents of the Shelby Steel Tube Co., offer to send one of these paper knives to any reader of Canadian Machinery who will write for same on their business stationery. With the paper knife will be mailed some interesting literature on Shelby Steel Tubing.

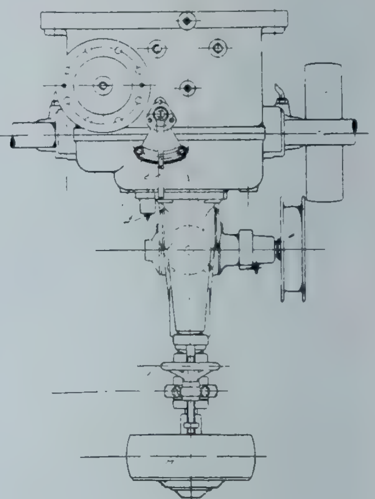
Peiler & Co., Montreal.

The firm of Peiler & MacKenzie, of Montreal and Toronto, was dissolved on the 31st August, by the retirement of Mr. MacKenzie, and the business is being continued by Mr. Peiler under the name and style of H. L. Peiler & Co.

The new firm continue to be general representatives in Eastern Canada of the "Bundy Department" of the American Radiator Company, the Mason Regulator Co., the P. B. Huyette Co., and Berry Engineering Co.

Mr. Peiler personally has charge of the Montreal office, while at the Toronto office, 404 McKinnon Building, Donald Russel is manager of the firm's Ontario interests. With the experience which these two gentlemen have acquired as specialists in the economical handling of condensation, in pressure regulation and other details of power plant economy, the new firm are particularly well equipped to take care of the interests of their customers. Messrs. Peiler's motto is: "It is not what is paid for an article, but what that article pays back in return for its cost, that determines its true value." After all, this is the key-note of modern engineering.





Oil Pressure Governor.

Canadian Casualty & Boiler Insurance Co., Montreal.

Robert Law has been engaged by the Canadian Casualty & Boiler Insurance Co., and the General Accident Co., Continental Life Bldg., Toronto, to look after their interests in Montreal. His headquarters will be in the Bell Telephone Bldg. Mr. Law is a marine engineer with an extra Board of Trade certificate. For some time he has been a boiler inspector for the National Boiler Insurance Co.

One of the Simplest Means of Economizing in Fuel

Economy of Saving Heat Units in Water of Condensation which comes from Drying and Heating Apparatus at Canadian Colored Cotton Mills, Cornwall.

Editorial Correspondence.

Recently a paper on "The Saving of Heat Units," was read before the Canadian Association of Stationary Engineers by H. L. Peiler, of Peiler & Co., Montreal. In his paper Mr. Peiler referred to an installation of traps at the Stormont mill of the Canadian Colored Cotton Mills Co., Cornwall.

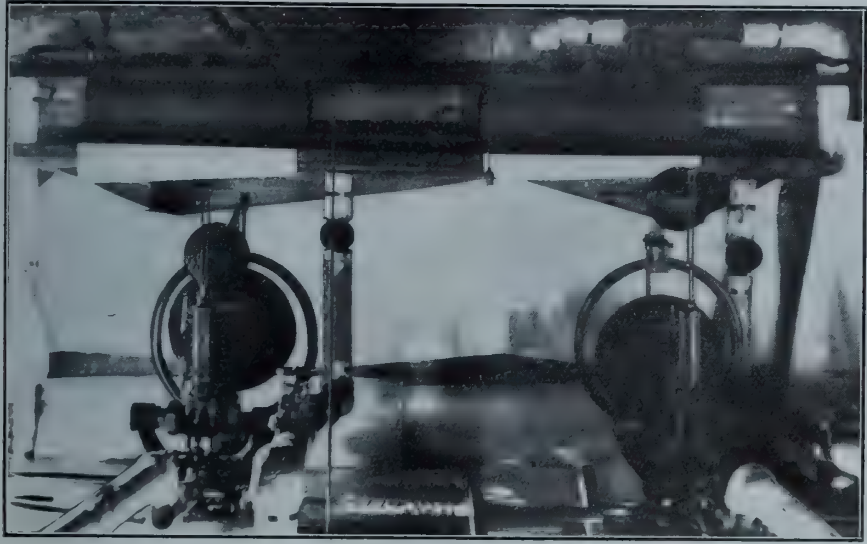


Fig. 1.—Two Bundy Return Traps Discharging Into Boiler.

In this plant the average temperature of the boiler feed was 165 degs., five 80 h.p. boilers were used to do the drying and dyeing. Since the installation of traps, about 80 per cent. of the feed-water goes back direct to the boilers through return traps at 140 degs. making the average temperature of the boiler feed 252 degs. F. This shows a gain of 87 degs. with a theoretical saving of about 8 to 9 per cent. in fuel.

Two of the boilers have been shut down, the other three are more efficiently operated and the actual saving in fuel is over 30 per cent. allowing for the fact that a portion of the dyeing plant has been removed to another mill. This was originally a receiver and pump lay-out with the make-up water running into the receiver tank to cool the returns. The only change was to handle the returns independently from the make-up. The cost of making the change, it is claimed, pays for itself in this plant every six months.

Canada Mill, Cornwall.

The accompanying illustrations show a number of the installations at the Canada mill of the Canadian Colored Cotton Mills Co., at Cornwall.

Fig. 1 shows two No. 105 or 2½ inch Bundy return traps each discharging 142 pounds of water into the boilers per operation. Note that the trap on the left is receiving water by gravity from the closed receivers overhead, while the trap on the right is discharging its load into the boilers below. All condensation in the mill is brought by pressure to the two Bundy trap receivers shown above the traps. It will be noted in Fig. 1 as well as in the other illustrations that all piping is covered.

Fig. 2 shows a group of three Bundy tank traps in the eastern end of the weave shed. The trap A and trap B take the condensation from machinery and radiation in the stores building 40 ft. distant. Trap C drains the heating radiation of the eastern side of the weave shed. All three discharge overhead to the boiler room 250 ft distant, with vertical lift of 35 ft. to closed receivers over boiler traps shown in Fig. 1.

A Bundy steam operated lifting pump trap No. 102 is shown in Fig. 3. This trap takes water from 3 slashes at 2 lbs. pressure by gravity and discharges it to boiler room about 400 ft. distant.

Fig. 4 shows a Bundy trap draining the condensation from the heating coils in the dye-house and bleaching room. The trap discharges overhead and back 350 ft. to boiler room with vertical lift of 30 ft. Note that the return line is covered.

The three Bundy traps shown in Fig. 5 are located at the west end of the weave shed. Trap A drains all the radiation in the main mill, 100 ft distant and discharges it back to main boiler house, about 400 ft. distant. Traps B and C are also on the circulation of tower and weave shed. All the return lines are now covered although only one was covered when the photo Fig. 5 was made.

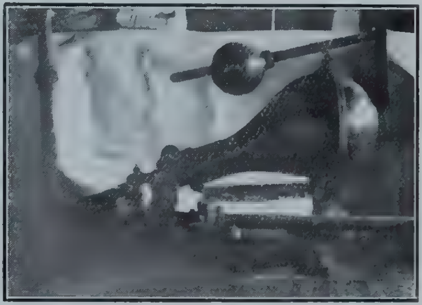


Fig. 3.—Bundy Lifting Trap.

Fig. 6 shows the general plan of the Canada mill showing the location of traps at various points. All circulation of the main mill runs by gravity to a common point near the wheel house shown at the left, and thence to the basement of the weave shed where one No. 56 (1½ inch) Bundy tank trap is located. Traps of No. 50 series are tank traps on high-pressure lines. Traps of No. 100 series, including boiler return traps, are steam operated, taking water from low-pressure apparatus and discharging by live-steam pressure.

The Solved Problem.

In solving the problem, how to save the heat units, each machine or group of machines such as the slashers, was

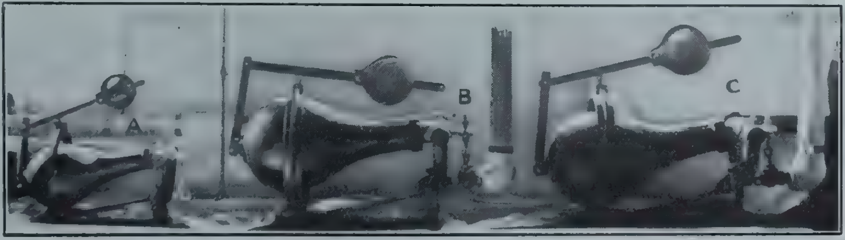


Fig. 2.—Bundy Tank Traps in Basement of Weave Shed.

provided with a trap of sufficient capacity to take care of the maximum amount of water which it would condense. The important factor is not merely to drain the water off, but to drain it off promptly, as quickly as it forms. As the water had to be returned in some case about 500 feet to the boiler-room, and then lifted vertically about twenty feet to the new receivers over the boiler-level, adequate pressures had to be provided to obtain the motive power.

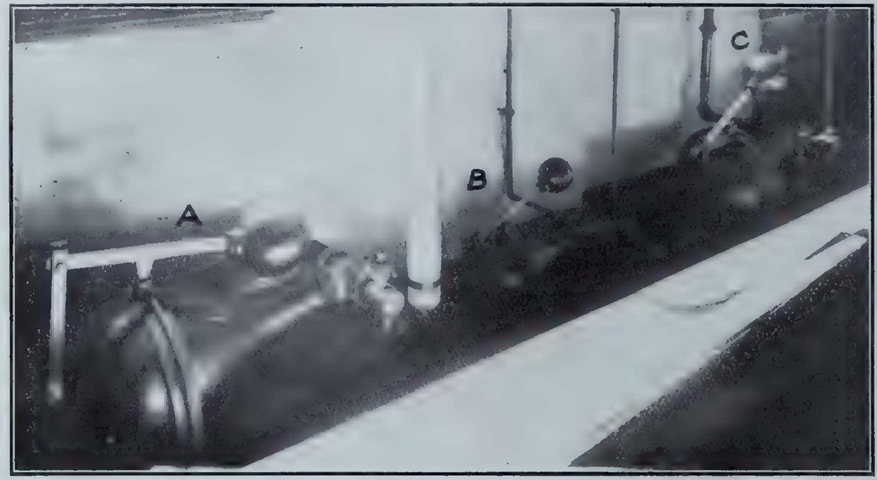


Fig. 5.—Three Bundy Tank Traps in Weave Shed, Canadian Colored Cotton Mill Co.

As the pressure in the main mill was only 80 lbs., it was only necessary to place at the lowest drain point an ordinary Bundy trap of sufficient capacity. This trap, a one and a half inch, having a valve opening of the full size of the trap inlet and outlet with fifty pounds pressure at the trap, readily discharges 230 pounds of water per minute along a horizontal drive of 500 feet with a lift of twenty feet into the receiver.

The condensation from the three slashers is led to a small header in the basement to a Bundy steam operated trap which discharges it to the receivers over the boilers. Similarly each steam using machine was considered and traps installed to remove the water and discharge it as rapidly as possible to the boiler room receivers.

Eleven return lines have been replaced by one main return shown in Fig. 6. This return was run from the west end of the weave shed, along the ceiling of the basement, and where this line turns to run into the boiler-room it was joined by a short line from the trap draining the main supply pipe, and by another main running from the east end of the weave shed. So that one line enters the boiler-house carrying all the condensation from the main mill, weave-shed and storehouse, and, in fact, everything save the dye-house and bleachery.

Another main takes in the whole bleachery and part of the dye-house, while the third main carries the returns from wool-drier, warp-driers and dye-house circulation. In all only three lines now enter the boiler-house, all of which run upward and discharge into two small closed cast-iron receivers placed about ten feet higher than the boilers.

The whole system is closed tight and operates as follows:

The quick positive discharge of the Bundy trap forces this water in a few seconds over to the receiver. It then drops by gravity to the return trap. When the return trap is full its bowl drops, opening a live-steam connection direct from the boiler, that equalizes the pressure in the trap and the boiler, and immediately the water in the trap flows by gravity into the boiler.

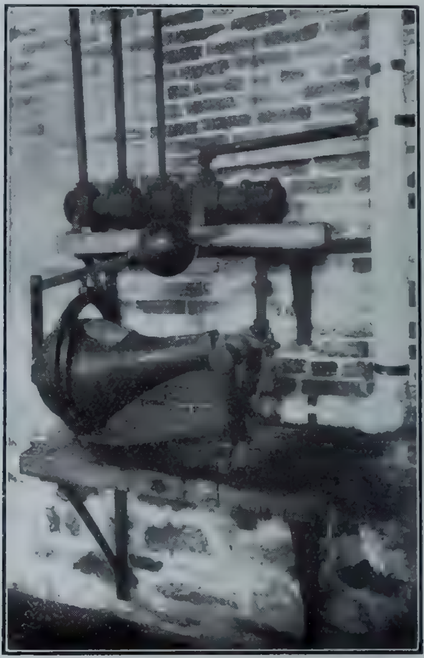


Fig. 4.—Bundy Traps Draining Dye-house Heating Coils.

Installations have also been made in the Marysville and Milltown, N.B., plants of the Canadian Colored Cotton Mills Co. All these plants show big reductions in fuel bills as a result of the installations and it has been accomplished by saving the heat units

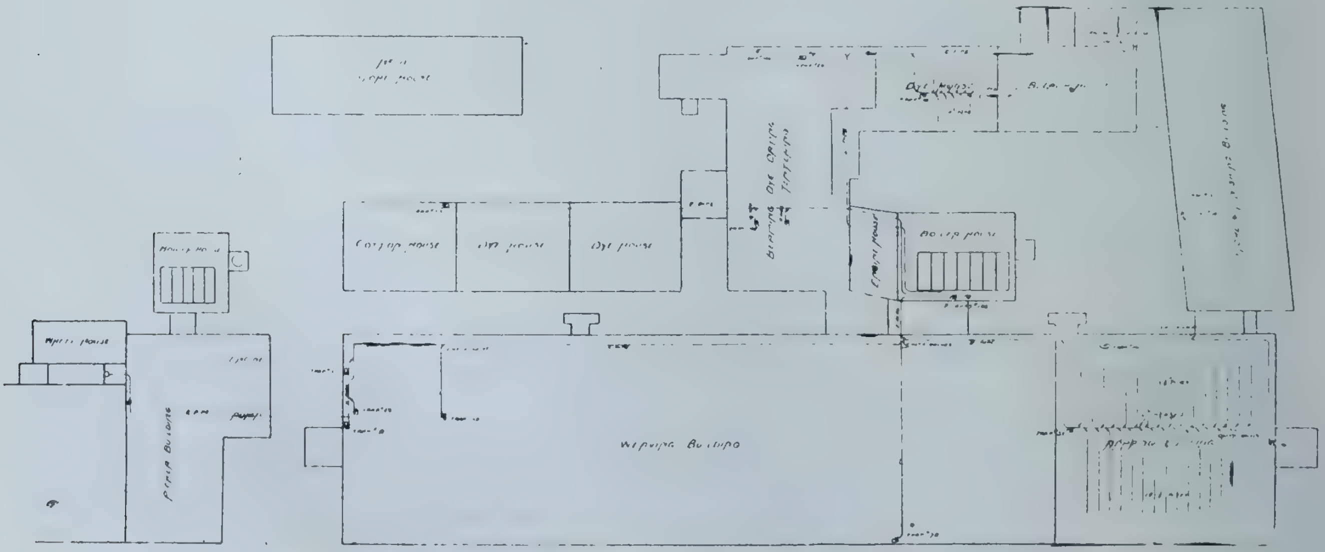


Fig. 6.—General Plan of the Canadian Colored Cotton Mill, Cornwall.

Superheated Steam and Its Relation to Cheap Power*

A Review of the Improvements that have been made in Superheated Steam Practice to Utilize it to Better Advantage in the Production of Power.

By H. G. Bertram, B.Sc.

Steam in contact with water is always saturated and must have a definite temperature and a definite volume per pound, depending entirely on the pressure under which it was formed. If we heat a quantity of water in an open vessel the temperature will rise until it reaches about 212 deg. Fahr., and then for some unforseen reason it will refuse to rise higher, no matter how much extra heat is added. Some result is seen, however, in the formation of water vapor or steam, and if the heating is continued long enough the water will be completely vaporized. The steam thus formed is called saturated steam, formed at atmospheric pressure, and one pound occupies a volume of 26.36 cubic feet.

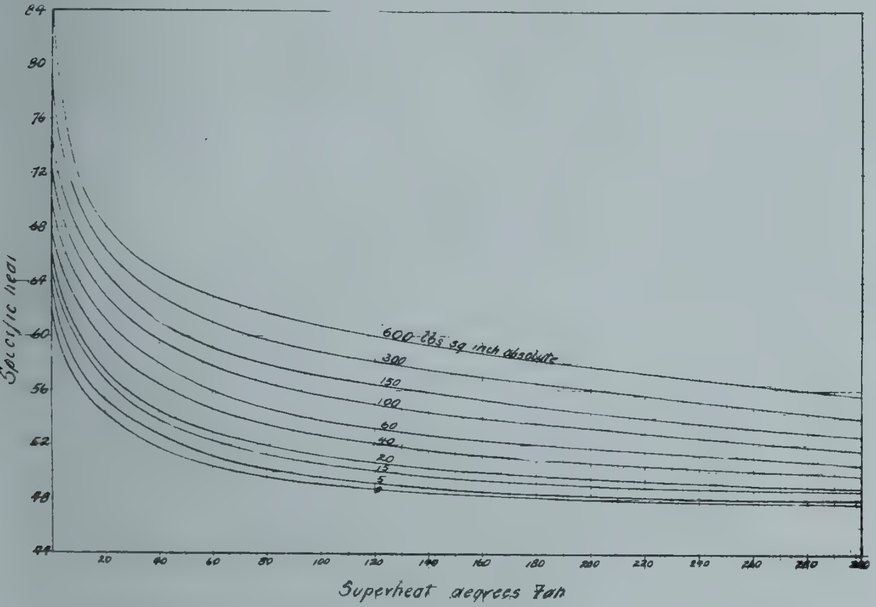


Fig. 1.—Mean Specific Heat of Different Pressures and Degrees Superheat.

If, however, instead of having the water free to the atmosphere, we enclose it in a vertical cylinder fitted with a piston, we can apply to its surface any desired pressure by merely loading the piston with weights. If we apply a total pressure of 100 pounds per square inch and heat over a flame as before we will find that the water does not vaporize when the temperature is 212 deg., and not unitl 337.6 deg. F. is reached do we have steam formed. At this pressure one pound will occupy 3.82 cubic feet, and at the moment that the last drop disappears we have what is known as dry saturated steam. This is the dividing line between saturated and superheated steam, or, more correctly, the point at which a further addition of heat will make the steam take the superheated form.

This experiment can be conducted with any desired pressure on the water or steam, and thus we see that superheated steam may be formed at any pressure by heating the dry saturated steam and that the degree of superheat is entirely independent of the pressure at which the saturated steam was formed. Its physical properties differ widely from those of saturated steam; the higher the degree of superheat the more nearly it approaches the condition of a perfect gas, and it may be expanded adiabatically to its saturated point without being liquified. When highly superheated steam is heated, the increase in volume is probably the same as for a gas, that is, a volume of V cubic feet at a temperature of t degrees F, becomes

$$V.\frac{461+t}{461+t}$$

when raised to the temperature of t degrees F.

This only holds good for high superheats. Near the saturation point it expands more rapidly, probably due to the evaporation of minute particles of water suspended in the steam.

Specific Heat of Superheated Steam.

The specific heat of a substance is the quantity of heat required to raise the temperature of a unit weight of the substance, one degree, and the importance to the engineer of knowing as accurately as possible the specific heat of superheated steam, can be understood when we consider the following questions:

(a) How much does it cost with a given efficiency of steam heating to produce superheated steam of a given pressure and temperature at a given rate?

(b) What amount of heat energy is available per pound of superheated steam of a given pressure and temperature?

The British thermal unit (B.t.u.) is the unit used almost altogether by English-speaking people to measure the quantity of heat in a substance. It is defined as the quantity of heat that is required to raise the temperature of one pound of water through one degree F., and since this definition also applies for the value of the specific heat of water (which is approximately =1) we can find the heat added to a quantity of water by multiplying the weight by the rise in temperature. For example, if we heat ten pounds of water from 60 deg. F. to 75 deg. F. the heat added would be

Weight×rise in temp.×specific heat.

$10\times(75-60)\times1=150$ B.t.u.

In the steam tables to be found in most engineers' handbooks, we can obtain directly the heat in one pound of saturated steam, corresponding to any pressure, but when the steam is superheated we have to apply the formula:— $H=Cp(T_2-t_1)$ to find the quantity of heat after the saturation point was passed.

Cp=mean specific heat of saturated steam at the given pressure.

T_2=temperature of superheated steam absolute.

t_1=absolute temperature of the saturated steam.

(Absolute temperature being the temperature as given by a F. thermometer +461).

Cp may mean the true specific heat or the mean specific heat at constant pressure. The true specific heat is the specific at a point and is not of much value to engineers for practical work, except as a means for finding the mean values. The mean specific is the average amount of heat required, per degree, to change the temperature of the superheated steam from one temperature to another, and it is this value that is used in the above equation.

Until recent years the value used for the specific heat was that supplied by Regnault, who found by experiment

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* First of a series on Superheated Steam. The second article will deal with the advantages due to the use of superheated steam in engines. The third paper will deal with superheaters.

Cp=4805, but careful experiments have revealed the fact that the specific heat is not constant, but variable, depending for its value on the pressure and degree of superheat.

The men who have lately taken the most prominent part in the experiments with the object of obtaining accurate figures, are Knoblauch & Jakob, and Thomas.

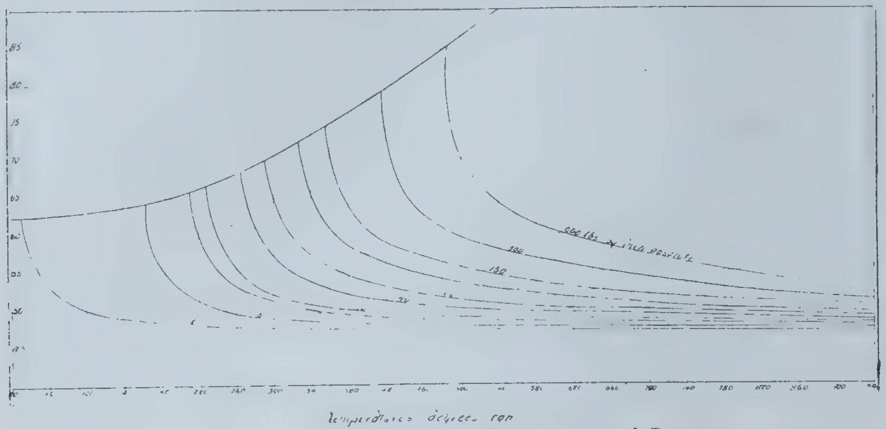


Fig. 2.—Relation of Specific Heat to Temperature and Pressure.

Electric heaters were used entirely, the heat being derived from a measured electric current, and elaborate schemes were followed to prevent radiation, and to measure any unavoidable loss.

A comparison of the curves presented by these men was made by Prof. Hech, of South Bethlehem, Pa., in volume 30 of the transactions of the A. S. M. E., in which he stated that although the curves were slightly close to the saturation points, the results given by either Knoblauch & Jakob or Thomas might be used in working up a boiler list without producing any appreciable error into the calculations. But for more accurate work in the superheat field, only the variation of the curves is of importance, and work of this nature must have about it an element of uncertainty until the question has finally been decided.

The accompanying curves are those derived by Prof. Thomas, as a result of his experiments.

From Fig. 1, the values of the mean specific heat corresponding to pressures varying from 5 to 600 lbs. per square inch absolute, and temperature up to 300 deg. F. superheat may be read directly. Fig. 2 gives the relation of the mean specific heat to the temperature and pressure.

The conclusions drawn by Professor Thomas to apply to pressures from 7 to 500 lbs. abs., and up to 270 deg. F. superheat for all the above pressures are:

1. The specific heat varies with both pressure and temperature. It increases when the pressure of the steam increases, and diminishes with an increase of temperature.

2. The specific heat increases and decreases more rapidly when near the saturation point, with an increase of pressure and temperature, respectively, than is the case further from the saturation point.

A new series of experiments is now in progress, under the direction of Prof. Thomas, at the University of Wisconsin, and it is expected that they will throw important light on the relative accuracy of the investigations already completed.

Removing Water of Condensation in Steam Heating

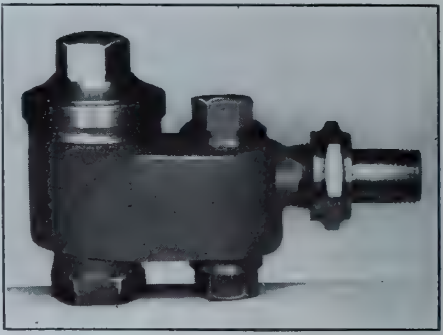
Some Interesting Installations of the "Economic" Automatic Vacuum Valve, showing Recent Improvements made in its Design.

On Feb. 11, 1908, the Canadian Steam Boiler & Equipment Co., 186 Queen St., east, Toronto, obtained a patent for a vacuum valve which has been described in The Power House. Since then several improvements have been made in its design, which renders it more efficient than heretofore.

A longitudinal vertical section through the valve shows that the valve has two chambers, the first being a dirt chamber in which the condensation is screened before entering the second chamber. The second chamber, containing the float, is a perfect valve, retaining the steam eliminating the air and water of condensation automatically by action of the valve. The valve is seated, the float having a bearing on the centre pipe. The valve is also water sealed. The float is about $\frac{1}{8}$ inch above the bearing surface, so that pressure is equalized on the inside and outside and outside of the float.

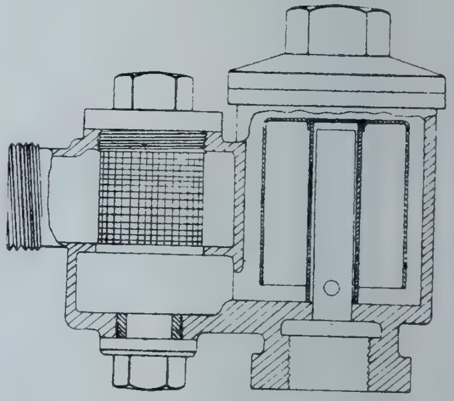
There is a small hole in the top of the float, making it suitable for a heating system valve. When under pressure of steam the hole is closed. As the float is both seated and water sealed, it makes an excellent trap.

Many interesting installations of the improved trap have been made at the Longue Point Asylum. The trap was tried under 100 lbs. pressure, and it is practically working as a steam trap. In this case the hole in the float, used with a vacuum pump on the system, is closed.



"Economic" Vacuum Valve, Canadian Steam Boiler Equipment Co., Toronto.

In a confectionery factory in Toronto the valve is used under 10 ins. vacuum, giving good satisfaction. About fifty are used on this system.

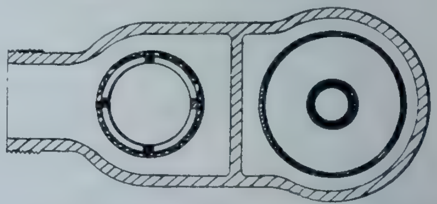


Vertical Longitudinal Section of Economic Vacuum Valve.

Unique Installation.

A very interesting and unique installation was recently made by W. Schulkins, plumber and steamfitter, 934 College St., Toronto. About forty valves were installed in a heating system. The vacuum is formed by a pipe from the receiver being led into a 2-in. pipe through the chimney. Besides the heating system being drained, the condensation from a line of glue pots is carried away.

This valve was invented and improved by Z. Hemphill, Manager of The Canadian Steam Boiler & Equipment Co.



Horizontal Section of Economic Vacuum Valve.

The Relation of Character of Coals to Smoke Prevention

Discussion of Coals, their Relation to Smoke Abatement—Furnace Design and Reasons for Smoking Furnaces, and for Preventing Smoke.

By D. T. Randall *

The semi-bituminous and bituminous coals are the most extensively used of all the fuels which are available for generating steam. Containing, as they do, a considerable quantity of volatile matter, which is given off when the coals are heated in the furnace, it is difficult to burn them under boilers so as to secure perfect combustion and freedom from smoke. Specially designed furnaces and careful operation are required to get good results.

The difference in the character of coals is only partly shown by the proximate analyses which are commonly used, but to one familiar with coals these analyses indicate in a general way the leading characteristics of the coals.

To show the difference in fuels Table 1 has been prepared.

TABLE 1.

Analyses of Fuels as Delivered and Used.

	Coke	Anthracite Pea Coal	Pocahontas Coal	Pittsburgh Coal	Indiana Coal
Moisture	4.67	4.75	1.12	2.48	9.62
Volatile Matter..	2.82	2.90	17.24	38.74	36.14
Fixed Carbon..	82.61	77.15	74.84	49.18	41.22
Ash	9.90	15.20	6.80	9.60	13.02
	100.00	100.00	100.00	100.00	100.00
Sulphur	———	0.80	0.71	1.85	4.43
B.t.u.	12206	11886	14530	13172	11122

It will be noted that coals very both in their composition and in their heating vaules (B.t.u.) and in consequence they are more or less valuable as fuel, depending on these variations.

Other things being equal, a fuel high in fixed carbon is more easily burned in a common furnace without loss of heat and without smoke than those of lower percentages. Coke and anthracite coals are examples of this class of fuels.

The percentage of moisture is not of great importance, except in cases in which the coal is naturally high in moisture, or in which the coal is very wet as a result of washing or exposure to storms. Moisture in small percentages seems to aid combustion, but in larger amounts it retards the ignition of the gases and lowers the furnace temperature. It may or may not increase the smoke, depending on the character of the fuel.

The percentage of ash, and especially the character of the ash, is of importance in connection with the smoke problem. Ash which is fusible and runs down on to the grate bars may cause smoke by shutting off the flow of air through the fuel, and by increasing the poking which is necessary to keep the grates free. Coals which clinker badly require more attention from the fireman, and poking the fire is a common cause of smoke.

There is a great difference in the behavior of the same coals when burned under different furnace conditions, and in different furnaces. Some grates and stokers are adapted to handle coals which are burned with great difficulty on other equipment.

The rate of burning per square foot of grate is often the deciding factor as to whether a given coal may be used or not. This is principally due to the higher temperatures which are obtained with high rates of combustion, and its effect on the fusible portion of the ash of the coal. Investigations are now being made to determine the characteristics of the ash of representative coals, as related to the clinker formed at various temperatures.

So far as smoke is concerned, the volatile matter is of the greatest importance. The quantity of volatile matter is not a true measure of the difficulty of burning a coal, but to one familiar with

Table II. gives some idea of the complicated relation between the temperature of the coals in the furnace and the compositions of the various gases to be burned. Investigations of this characthe various coal fields it is of great assistance in choosing a suitable coal or in designing a furnace suited to the given coal.

Investigations relating to the nature of volatile matter in representative coals have been carried on at the Government fuel testing plant, at the University of Ohio, and at the University of Illinois.

The results show that the differences in the gases given off from coals may be due to the composition of the coal and to the temperatures to which the coal is subjected when placed in the furnace. The higher temperatures tend to distill the volatile matter more rapidly and drive off the heavy hydrocarbon in forms which are difficult to burn without smoke. ter are necessary to determine the characteristics of coals from each of the representative beds.

The combustion of coke or other fuels high in fixed carbon is comparatively simple. The greater portion of the fuel is burned on the grate; the remainder in the form of gas burns at a short distance above the bed of fuel. This may readily be observed on a fire of anthracite coal in which there is only a small percentage of volatile matter.

In burning bituminous coals, however, the difficulties are much greater, and for the reasons given above. The volatile matter from some coals is set free more readily than from others, and with some coals the nature of the volatile matter given off is such as to make it very difficult to secure complete combustion. Smoke is an indication of incomplete combustion, and the problem of reducing the amount of smoke is important, not only from the standpoint of the smoke inspector, but also because of the losses in combustible gases, such as carbon monoxide (CO) and hydrogen, which escape with the smoke.

TABLE II.

Absolute Quantities of Smoking Products in Ten Minutes Heating at Different. Temperature**

Coal	Temperature Degrees C		Smoking Products	
	Furnace	Coal	Tar	C_6H_6—c.c.
3 Connellsville	600	441	4.9	61
1 Ziegler	600	440	6.8	51
3 Connellsville	700	562	11.0	145
1 Ziegler	700	545	7.8	24
16 Pocahontas	700	599	4.2	138

** See paper by Porter & Ovitz in Journal of American Chemical Society, Vol. XXX.

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* Engineer in charge of Fuel Engineering Department, Arthur D. Little Laboratory of Engineering Chemistry, Boston.

Experiments by several investigators have shown that whenever smoke is given off there is also a considerable quantity of carbon monoxide gas, and that as a rule this gas is accompanied by small percentages of hydrogen and hydrocarbon compounds. The losses due to these combustible gases, which are found in connection with a smoky stack may very between one and ten per cent. of the fuel.

TABLE III.

Showing Relation of Smoke to CO in Flue Gases***

Average Per cent. of black smoke ..	0	7.1	15.5	24.7	34.7	43.1	52.9
Average per cent CO in flue gases	0.05	0.11	0.11	0.14	0.21	0.33	0.35
Number of Tests Averaged	37	18	56	51	36	17	4

*** See U.S. Geological Survey Bulletin 325, pages 101 and 167.

TABLE IV.

Showing Relation between CO in Flue Gases and other Combustible Gases****

Boiler Furnace ..	Smoky CO_2	CO	CH_4	H_2	Clear CO_2	CO	CH_4	H_2
Hand Fired	10.95	3.00	0.70	3.23	8.15	0.0	0.0	0.0

**** See Manchester (England) Smoke Abatement Report.

When burning a bituminous coal, the volatile matter must be raised to a high temperature, while mixed with a sufficient quantity of air and burned on its passage from the fuel bed to the surface of the boiler. In most boiler settings this distance for combustion is very short, and when the gases strike the cold surfaces of the boiler shell or tubes they cool below the temperature at which they will burn rapidly, and as a result some escape unburned and others are only partially burned, as shown by the heavy deposits of soot. In properly designed furnaces the space provided for combustion is large for coals giving off high percentages of volatile combustible. Even in such furnaces the firing must be carefully done, or at times enough air cannot be supplied to the gas, and smoke results for short periods. In most plants the time required for the gases to pass from the fuel bed to the top of the stack is between 10 and 15 seconds. Assuming the velocity to be reasonably uniform at different sections, then it will be seen that the gases pass from the fuel bed to a distance of say 12 feet in one second. At the end of this period there is but little opportunity for the gases to burn. This will make clear the great importance of a sufficient air supply, properly distributed, and an ample space above or back of the grates in which the gases may thoroughly mix and burn within considerably less than one second of time.

That there is a loss due to the volatile gases escaping unburned from an ordinary furnace is shown very clearly by the results of tests made on house-heating boilers. Table V. gives figures obtained on two series of tests for the purpose of determining the fuel values of several coals and briquets,* when burned in a house-heating boiler.

The furnace in which the results shown in Table V. were obtained is best suited to coke, anthracite, or low volatile coals, and, as will be seen, is not adapted for burning bituminous coals, with good efficiency, yet many furnaces having practically the same features, such as a grate surrounded by heating surface, and a small combustion chamber, are used in power plants for burning high volatile coals.

Even with furnaces of improved design it is difficult to charge the coal by hand-firing and secure smokeless combustion. This is due to the fact that a comparatively large quantity of gas is liberated immediately after firing, at the same time the fuel bed has been thickened and the air enters with more difficulty and without being well distributed with respect to the gases rising from the bed. With such a furnace the loss of combustible gases may be reduced to 5 per cent. or less, depending on the coal and the operation.

It is because of the advantage in having the coal gradually heated and the gases distilled from it at a low temperature that a mechanical means of feeding the coal to the furnace is usually more successful in the prevention of smoke.

A good furnace should permit the burning of bituminous coal in sufficient quantities without loss of escaping gases or the formation of smoke when the air supply is about 50 per cent. in excess of the theoretical amount.

Even after the best types of furnaces are installed it is necessary to supervise the operation of the boiler plant closely to secure the best results. The proper drafts, the best thickness of fire for any given coal when burned on grates at the rate required for the plant, and the best method for the removal of ash and clinkers to prevent loss of fuel into the ash pit are all factors in securing the highest economy. Failure to attend to these important details may easily cause a loss of as much as ten per cent. in the fuel fed to the furnace.

In conclusion:—

1—Even well designed furnaces may be expected to give off smoke if improperly operated, or under any of the following conditions:

(a) When a new fire is built in a cold furnace.

(b) When an excessive amount of coal is burned on the grate, making it difficult or impossible to properly mix the air with the gases and burn them in the furnace.

(c) When the rate of combustion is suddenly changed, due to a change in demand for steam, for the same reason as under (b).

2—Smoke may be reduced and in most cases prevented:

(d) By burning a fuel having a small amount of volatile matter.

(e) By burning a bituminous coal in a specially designed furnace with more than ordinary care on the part of the fireman under the supervision of a competent engineer.

TABLE V.

The Relation of Volatile Matter of Smoke and Unconsumed Gases.

Number of Tests Averaged	Volatile Matter in the Combustible	Ash in Dry Coal	Efficiency	Black Smoke	CO in dry Flue Cases
4	18.30	8.00	60.56	18.2	0.44
12	22.71	8.94	56.33	18.0	0.50
7	34.70	11.27	54.11	22.1	0.55
11	38.79	15.02	47.19	30.8	0.62
16	44.46	14.57	47.19	32.9	0.74

* See U.S. Geological Survey Bulletin page 366.

Power Plant for Combined Use of Water and Steam

The Power Requirements of an Industry Outstripping the Available Water Power Necessitated the Installation of an Auxiliary Steam Plant.

The expansion of No. 2 Mill of the Penman Co., Paris, Ont., necessitated the building of a much larger powerhouse, and the installation of a greater steam plant to assist the already overtaxed water-turbine equipment.

As originally built, the Penman Mill, No. 2, was driven by water power, enough of the latter being available from the Grand River to supply all the needs of the then small plant, which had a small steam auxiliary for emergencies. A couple of years ago the new plant was installed, the designs and details of the arrangement being due to F. W. McFarlane, Mechanical Superintendent for the company.

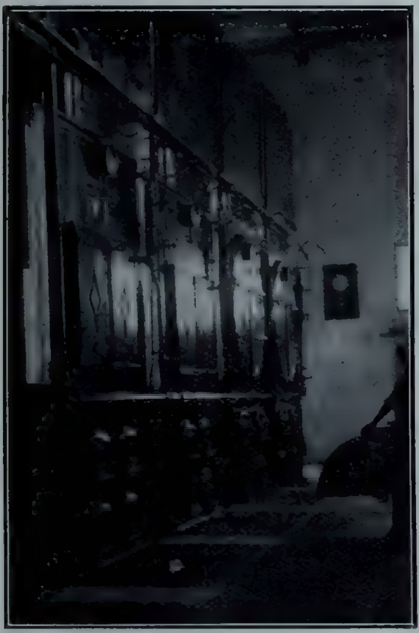


Fig. 1.—Boilers.

The plant is unique in several ways, both from the fact that it is adapted for either steam or hydraulic drive, or both, and from the compactness of the arrangement, and the great flexibility of operation, the plant being so arranged as to meet almost any exigency. A study of the arrangement as given in the description will show a plant that has required much careful forethought and calculation.

General.

The main part of the plant comprises the two lower floors of the south end of the carding and spinning mill, which was a new building at the time of the erection of the plant, while the turbine house is a one-storey extension from this south end, at the west side of the building. Across a 25-foot alley-way to the west is the boiler room with all its auxiliary equipment, while to the east is the power canal, located about 100 feet away from the building and parallel to it, running in a southerly direction.

Boiler Room.

The boiler room, the interior of which is shown in Fig. 1, is a building 47 ft. by 72 ft., interior, running east and west. The steam equipment consists of 5 72 inch by 18 ft. horizontal return tubular boilers, facing north, with space for an additional one. This space is at present occupied by an old boiler used as a storage tank for compressed air. All firing is done by hand, but it is expected that when the plant expands further, mechanical stoking will be introduced. Coal is handled by a car on a track running in front of the boilers, as shown in Fig. 1. This car holds approximately one ton, so that the record of the car-loads gives a check on the coal consumption. This part of the installation was supplied by C. V. Hunt, New York.

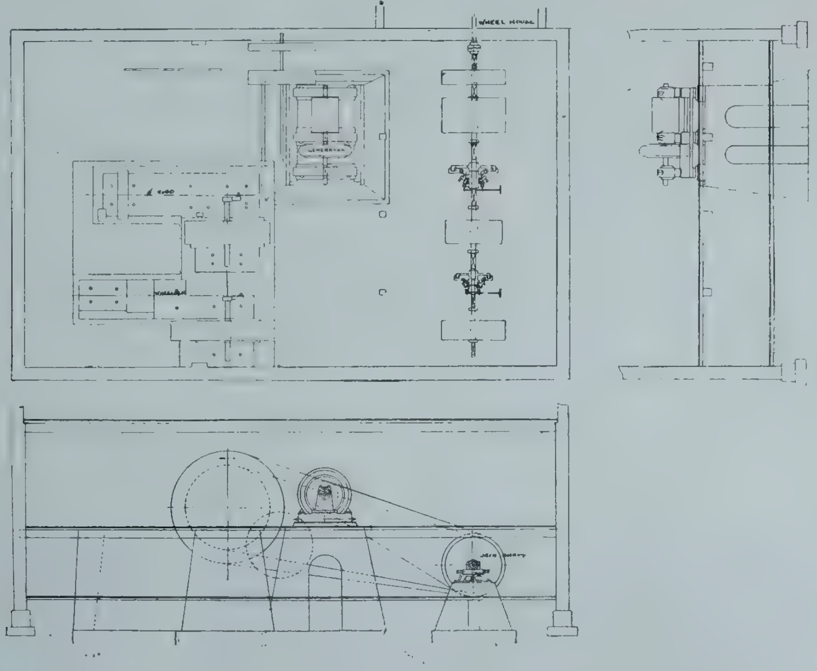


Fig. 2.—Engine Room Layout.

In the north-east angle of the building is located a 150 foot circular stack, with a 6 foot flue, built of hollow, porous firebrick, requiring no lining. The flue from the boilers to this stack is of sheet iron, 5 feet by 7 feet, rectangular in shape, and of uniform cross-section from end to end of the battery of boilers instead of diminishing in size towards the far end, Fig. 1. The object of this construction was to permit of the future addition of a fuel economizer. This, when installed, will be at the far end of the building, Fig. 1, reversing the draft, which will return to the stack through another flue.

A duplicate set of 12×7½×12 Burnham feed pumps, Fig. 3, located at the east end, supplies feed from a 500 h.p. Murphy enclosed feed water heater, also shown in Fig. 3. A 1000 h.p. Webster open heater in the engine room heats the water to about 180 degrees F., or thereabouts, and supplying the Murphy heater which raises the water to about 211 degrees F. before feeding into the boilers. For emergency purposes, a pipe runs from the Burnham pumps to the canal, and further protection in the event of these failing is provided by a separate connection to the boilers from a fire pump located in a small adjoining building. This is a 750 gallon Northey Underwriter fire pump, so arranged by selective piping that any building can be supplied as desired.

Chapman valves and Crane fittings are used throughout for steam connections, long bends being used for all turns. Each boiler supplies steam to the 9 inch main to the engine room, through a 5 inch pipe. From this 9 inch engine-room main are three branches, a 6 inch main going to the dye-house and for the auxiliary machinery, a 6 inch main for the dye-house alone, and a 4 inch main for the scouring house.

Engine Room.

The engine room occupies the second floor at the south end of the carding and spinning mill, as before mentioned. The general arrangement is shown in the engineer's drawing, Fig. 2.

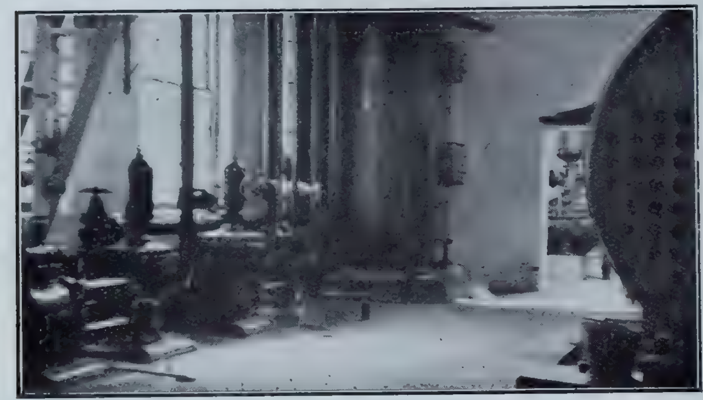


Fig. 3.—Boiler Room Auxiliary Machinery.

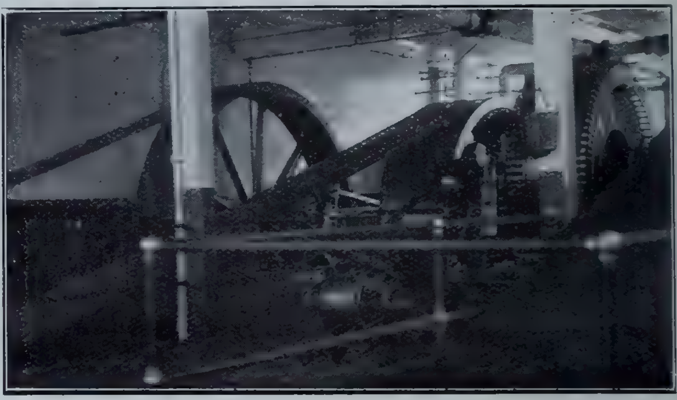


Fig. 4.—Engine Room.

The steam equipment consists of 280 h.p. Wheelock engine, 18×46, running 85 r.p.m., located along the north wall, and a 335 h.p. Robb-Armstrong Corliss engine, 22×36, running 100 r.p.m., located alongside the other about the middle of the room. The fly wheels of these are shown in Fig. 4. These two engines drive on a jack shaft located on the floor below, through passages in the floor. The Wheelock has a 16 foot by 32 inch fly wheel with a 30 inch 3 ply leather belt, while the Robb-Armstrong is 12 feet by 42 inches with a 36 inch 3 ply leather belt. The pier for the Wheelock, of solid concrete, slightly battered, is 6 feet wide, 30 feet long, and 18 feet deep, about 7 feet of which is under ground. The pier of the other is somewhat smaller.

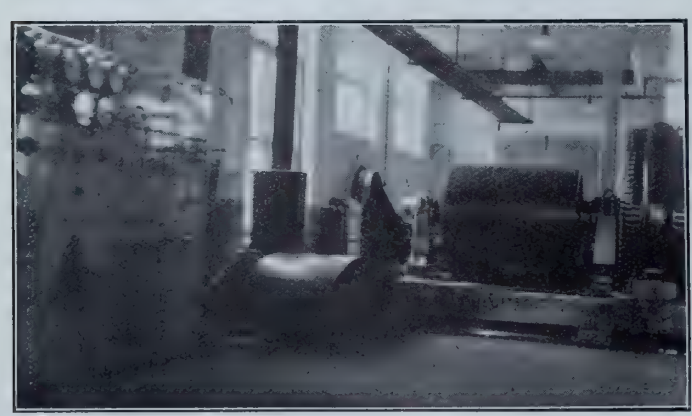


Fig. 5.—Switchboard and Generator.

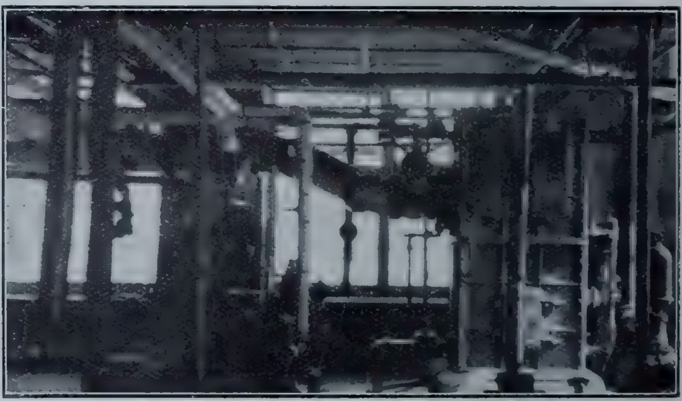


Fig. 7.—Auxiliary Machinery Under Engine Room.

A 5 foot 3 ply belt from the jack-shaft drives the 3 phase, 60 cycle, 600 volt, 450 k.w., 360 r.p.m., revolving field Canadian Westinghouse generator, which is shown in Figs. 4 and 5. A direct-connected 12.5 k.w., 125 volt exciter, to the left of the generator, Fig. 4, supplies the field coils. A very heavy 6 pier foundation is under the generator, each pier with a 30 inch cap, the whole joined together at the top as shown in Fig. 6. The idea in subdividing the base in this manner was to enconomize in space, as otherwise the basement would have been blocked at this point by such a gigantic, solid structure. There is an 18 inch footing under the whole base.

The switchboard, partially shown in Fig. 5, consists of 5 panels—4 electrical, and 1 steam. Two of the electrical boards are for engine room connections, while the other two are for distribution—one for power, and the other for lighting. To make mistakes impossible, every switch is marked. Conduit wiring is used throughout and every motor in the works has an air connection so that it may be cleaned out every Saturday.

On the floor below, directly beneath the engines, the auxiliary machinery is located, some of which is shown in Fig. 7. The exhaust piping is well planned, having connections for atmospheric or condenser exhaust, or the vacuum heating system, any one of these arrangements being readily made by globe valves. A 12 inch trunk exhaust main runs along the east side of the lower room, as shown by the large pipe in Fig. 7. At one end of this, as shown in that figure, is the 1000 h.p. Webster heater, while the other end of the main connects to the vacuum system. Between the two engine piers, which are to the left in Fig. 7, is located a 14×20×24 Deane surface condenser. Cooling water for it is drawn from the wheel pit and discharged there again. It is not customary to use the condenser, but when it is in operation, a 22 per cent. increase in power is possible. An 8×10×12 Knowles vacuum pump is connected Webster heater, a 5×7×10 low duty Burnham tank pump, shown in Fig. 4, is used. A Knowles 10×7×10 duplex supplies the water required in the dye-house and is also shown in Fig. 7.

Wheel Room.

The wheel room shown in Figs. 8 and 10, contains 3 Kennedy water wheels,—one a 37 inch, capable of developing 80 h.p. on a 12 foot head, and two 46 inches, with 150 h.p., each with a 12 foot head. Hung suspension is the method of support, in place of footstep bearings. The arrangement is plainly shown in Fig. 10, and makes clear the complete steel and concrete construction. The wheels are governed by a type Q, size 7½ Lombard water wheel governor to the right. to the vacuum heating system. For the Fig. 8, carrying 200 pounds oil pressure in a storage tank. A rotary pump supplies this pressure, as well as maintaining the necessary vacuum for the governor. The governor can completely close the gates in 2 seconds.

Three 8 feet square reinforced concrete flumes lead from gates at the race to the penstock. The middle gate at the race has a small central door to flood the penstock preparatory to placing the plant in commission. In the wheel-house an 8-ton travelling crane fills all requirements.

Jack Shaft.

The jack shaft is one of the special features of the plant on the whole, being its most vital part, for it is due to its construction that the plant is so remarkably flexible. It is well shown in Figs. 8 and 9, as well as the line cuts, Figs. 2 and 10.

Fig. 6.—Generator.

The pulley marked X, Fig. 9, is the main drive to the generator, the pulley to the left being from the Robb-Armstrong, and further to the left, not shown, the Wheelock pulley, while at the far end of the shaft, shown through the door, and more clearly in Fig. 8, are the bevel gears from the wheels. Between each of these five power units—the two steam engines and the three wheels—are placed Hill friction clutches, so that unit after unit of the water end may be put in commission as desired, and the rest of the parts left idle, or, if there is insufficient water or not enough power from that source, the power may be augmented by throwing in first the Robb, and next the Wheelock. The combination is excellent, as no dead running parts are required.

There is only one direct drive in the plant—that for the carding and spinning mill itself, the line shafting for which is driven from the pulley to the right of the main pulley, Fig 9, coming up to the casing shown in Fig 5, and being transmitted vertically as shown by the belt, all other drives throughout the plant are electrical.

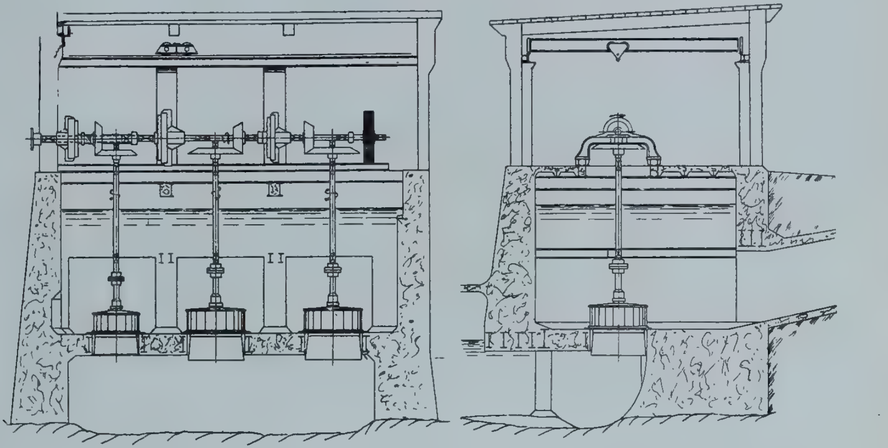


Fig. 10.—Wheel House, in Power Plant of Penman Co., Paris.

A characteristic feature bringing out the economical operation of the plant is shown by the method used for generating power for night lighting. Huge electrical display signs are used by Penmans on their factory, facing the railway line; and as it would be expensive to operate the large generator to supply this power, an auxiliary, driven by the belt shown alongside the wall, Fig. 5, is used. This belt is driven from outside the building from a pulley on a quill on the jack shaft. This quill has a clutch of its own, arranged so that when all other clutches are disconnected, it can be connected directly to the inner one of the three wheels—the small wheel—and thus operate only a single unit of the plant without a lot of shafting, etc. This produces a great saving. This same generator, which is an old Edison bi-polar, is so arranged that it can be used as the exciter for the big generator, in case of accident to the regular one.

A 1000 gallon Rodney Hunt rotative pump in the turbine house is connected to the jack shaft by a large frictioned clutch, and acts as auxiliary for the fire service. It connects to the underground fire system. The plant, as a whole, serves as an example of what can be done towards the economical installation and operation of a plant where compactness is a desirable feature.

ENGINEERING CLASSES.

The engineering classes in connection with the Young Men's Christian Association, Montreal, have started their season's work, under the able tutorship of Peter Bain, of Bain & Mitchell, consulting and contracting engineers. The course consists of steam engineering and boiler firing, workshop mathematics and advanced arithmetic, machine design and drawing office practice, and mechanical drawing. Quite a number of students have enrolled.

"ENDUROL" SHEET PACKING.

Turner Bros., 18 St. Peter St., Montreal, are placing on the market "Endurol" sheet packing, suitable for high or low pressures, superheated steam, oils, ammonia, alkalies, acids, sugar solutions, etc. A feature in connection with their sales is "No cure—no pay." Turner Bros. also handle belting and belt dressings.

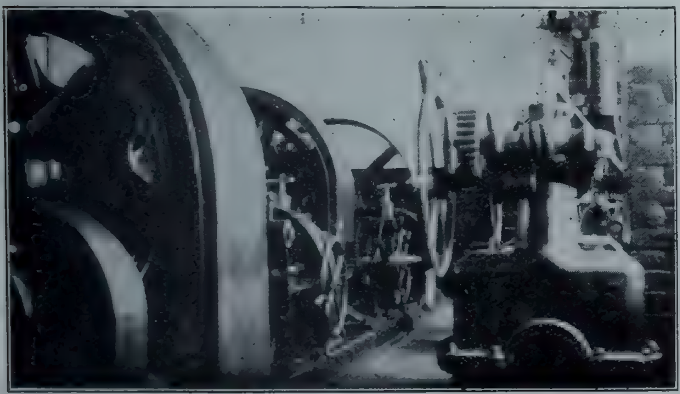


Fig. 8.—Wheel Room.

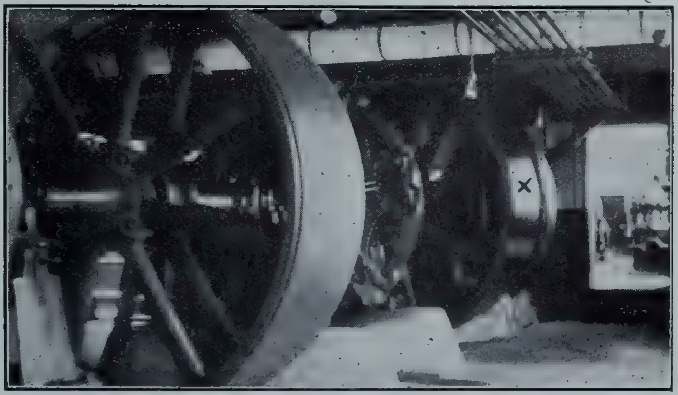


Fig. 9.—Jack Shaft Under Engine Room.

The Diesel Oil Engine

By Fred. H. Moody, B.A.Sc.

In view of the widespread interest in internal combustion engines of all kinds, it is strange that more attention has not been paid to the Diesel, which is an internal combustion engine operating along much the same lines as the usual four-cycle type, but with a few inherent differences, that appear to make for a better engine.

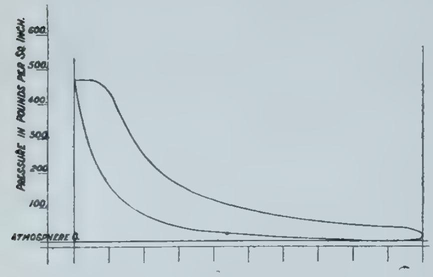


Fig. 1.—Typical Indicator Diagram from a Diesel Engine.

While this type of power seems to have come into its own very extensively in England and Germany and other parts of the world, but especially the latter country, where a very great number, indeed, are in operation, there seem to be very few on this continent, most of which are in the United States, for as yet Canada is with but one example—two ordered by J. B. McRae, consulting engineer, Ottawa, for a Moose Jaw plant.

Theory.

Sadi Carnot, the great French engineer, who was the first to lay down many of the laws of thermodynamics, in 1824 clearly defined a cycle of operation for the working fluid of any heat engine, the attainment of which would give the highest possible thermal efficiency for the limits of temperature between which the engine worked. To explain this cycle, two thermodynamic terms must be understood; viz., isothermal, and adiabatic, the former meaning constant temperature, and the latter, constant heat. Thus, if a gas be compressed isothermally, the temperature of the gas throughout this compression is constant. Similar reasoning shows that adiabatic compression of a gas means that the quantity of heat contained in the gas remains constant, which condition implies that the temperature undoubtedly rises.

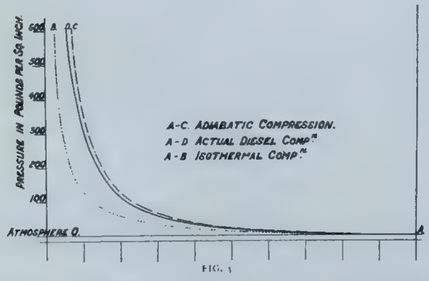


Fig. 2.—InPractice, Compression Curve Comes Between Adiabatic and Hyperbolic Curves.

In this theoretical cycle of Carnot's, there are four stages, (a) the gas is compressed isothermally, (b) next compressed adiabatically, (c) then expanded isothermally and (d) expanded adiabatically to its starting point, the operation (c) being made of such length as to ensure the latter point. Thus, summarized, Carnot's cycle consists of isothermal and adiabatic compression, followed by isothermal and adiabatic expansion, heat being withdrawn on the isothermal compression, and added on the isothermal expansion, the latter quantity of heat being greater, giving the resulting work. This cycle is the one all engineers try to emulate as it is the ideal.

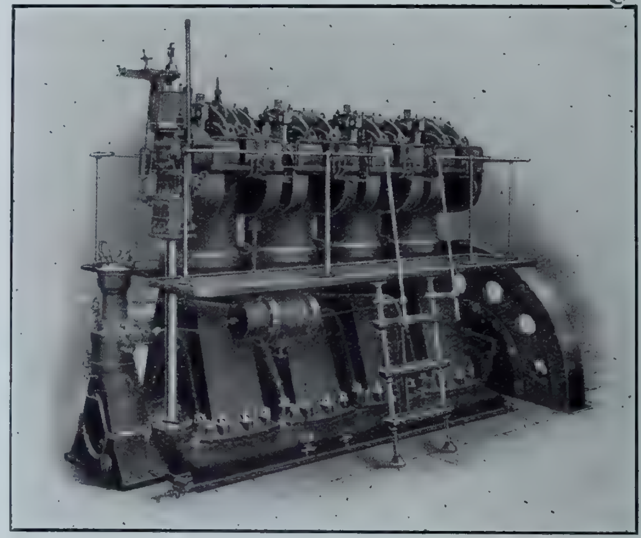


Fig. 4.—Four Cylinder 200 h.p. Mirrlees-Diesel Oil Engine.

The first commercial gas engine was that of Beau de Rochas, in 1862, which, while it didn't use Carnot's cycle, had the advantage of being practicable. This cycle of Beau de Rochas was developed in 1876 into a still more practical form by Otto, giving the very familiar cycle, the Otto cycle, on which most four-cycle engines operate. As just mentioned, it has the factor of practicability, which appeared to be lacking with the Carnot cycle. As is generally known, the Otto cycle consists of a suction stroke of air and gas, followed by a compression one near the end of which ignition occurs, exploding the mixture, which expands throughout the ensuing stroke, and finally the spent gases are expelled on the last stroke, when the operation is repeated. Thus two revolutions are required, except in case of scavenging engines, when air suction and expulsion strokes are included, making in all three revolutions or six cycles for this type.

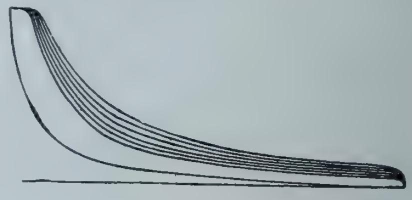


Fig. 3.—Variable Load Diagram Showing Governor Action.

It was left for Rudolf Diesel, a German professor, to make the first successful attempt at following the Carnot cycle. While the machine that he contemplated was not put on the market or even built, the patents and specifications for it were drawn up. As the specifications stated, his invention related to a process for producing power by means of heated air and gases, or a mixture of these in such a way that the combustion takes place isothermally, and that the following expansion should be adiabatic, reducing the temperature to that of the atmosphere. He contemplated regulating the temperatures of the gases in the cylinder, by the injection of too much air, so that water jackets would be unnecessary, thus doing away with this very wasteful feature. The fact that the spent gases were to be atmospheric when discharged eliminated another large loss. The weakest feature lay in the fact that pressures as high as 250 atmospheres were projected, with water injection to the cylinder, and 100 atmospheres without, the water to keep down the temperature of the compressed air to make first part of compression isothermal.

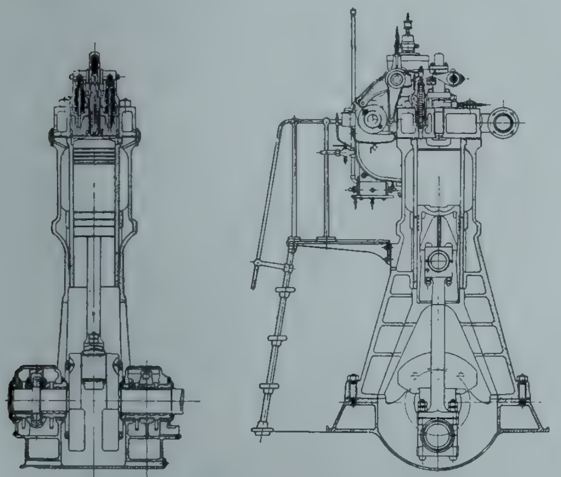


Fig. 5.—Vertical Section Through Mirrlees-Diesel Oil Engine.

Thus, it can be seen that the idea, if carried out, had the Carnot cycle very closely followed. However, this cycle from a mechanical standpoint had many weaknesses, especially as several separate cylinders were required, the first cylinder being used to compress the air isothermally by water injection, the second to compress adiabatically and so on. In order that isothermal combustion might be made possible, experience showed that the quantity of fuel burnt must be very small in relation to the air in the cylinder, giving a small amount of power proportionately to the size of the cylinder. The fact that expansion was to atmospheric temperature made the stroke unduly long, the latter part of it yielding but little power, thus tending to increase the size of the engine.

Actual Cycle.

The foregoing cycle, which was contemplated on the original Diesel engine, was for the practical reasons mentioned, changed, so that now it varies considerably from the theoretical cycle emulated. But this is but natural, as engineering feats are as a rule compromises between theory and practicability. As now made, the first stroke, the suction stroke, draws in plain air (not air and gas or vapor) which is compressed throughout the whole of the following stroke. These are all shown in Fig. 1. At the end of the stroke, when the air pressure is highest, oil is sprayed in, which ignites, and burns, not at a constant temperature, but as practice shows, at a very nearly constant pressure, through part of the ensuing stroke, and expand during the remainder of the stroke, the gas not being expanded to atmospheric conditions, but at a pressure considerably above, when it is expelled the loss in power being more than offset by the mechanical gains, in the same manner as a steam engine releases at a higher pressure than exhaust. During the last of the four strokes, the spent gases are ejected.

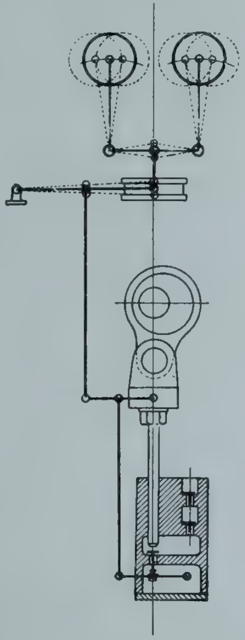


Fig. 6.—Showing the Duty of the Governor.

From this, it can be seen that the cycle while in general, like the Otto, has several distinctive features. To attain the high pressure necessary to ignite, a smaller percentage of clearance is essential. This pressure at the end of the stroke, has been determined from many experiments, to be best at from 450 to 500 pounds per sq. in. This creates sufficient heat to ignite oils of the highest flash points that would be used.

The curve followed on compression is very nearly adiabatic, as but little heat can escape on the usual quick acting engine. Reference to Fig. 2 shows from actual experiment, about what the compression curve is like. A B is isothermal, i.e. constant temperature, while A C is adiabatic. The actual curve lies between, though much closer to the adiabatic than the isothermal. If the adiabatic were followed, compression to 500 pds. from 60 deg. F. would result in a temperature of 1,110 deg. F., while from the Diesel compression, by actual computation, for 500 pds. per sq. in., the temperature would be 947 deg. F. Experience has shown therefore that from 450 to 500 pds. meets the needs of the worst oils, of slow running, and cold circulating water, as most oils have a much lower flash point than this.

The fact that just air and not an explosive mixture is compressed has several strong points in its favor. It has been found from long experience, that in internal combustion engines generally, the greater the initial compression, the greater the efficiency. The Diesel with its 450 pds. has an advantage over the gas engine with from 175 to 200. If these latter figures be exceeded, premature explosion may occur, causing greater strains in the engine than it was designed to withstand. Then again, a piece of red hot carbon, or a heated projection of the cylinder tend to cause premature explosion where a combustible mixture is compressed.

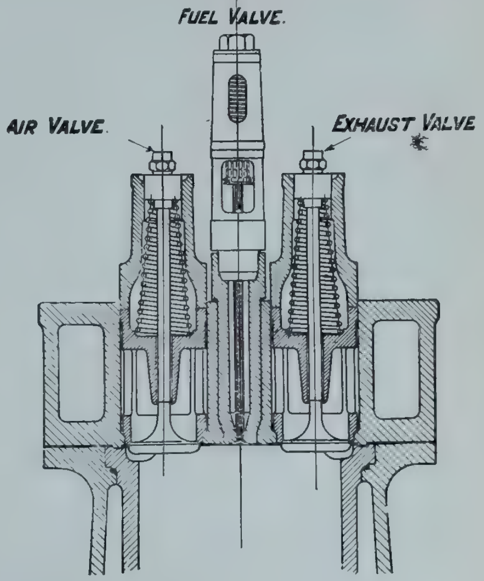


Fig. 7.—Valves of Diesel Oil Engine.

The really strong feature of the Diesel lies in its firing, for, as the oil takes an appreciable time to be injected into the cylinder, corresponding time is taken for the mixture thus formed to ignite. In place of the sharp explosion as with gas engines resulting in a maximum temperature and pressure practically instantaneously, in the Diesel engine, the burning being slow results in the temperature, using but little, while the pressure rises not at all, making the final pressure of compression the highest pressure in the cylinder. This assists towards easy running. Fig. 1 shows how like a good steam card the diagram from the Diesel cycle is, for the ignition line corresponds identically in both cases. When complete combustion has occurred, expansion takes place, followed by the exhaust.

The absence of sparking device, hot tube, or other mechanism for igniting is a strong feature, as it is here that much of the difficulty experienced in the usual Otto Cycle engine occurs. In addition, the slow ignition before mentioned keeps down the temperature, so that, while the pressure is greater than with a gas engine, the temperature is less.

As the oil does not require to be vaporized before injection, being merely sprayed in, thick heavy oils may be readily used, thus allowing the use of crude oil where lighter oils are required with ordinary oil engines working on the Otto Cycle.

Governing is effected by regulating the supply of oil to the engine, thereby reducing the area of the card. The sensitiveness of the device is shown by reference to Fig. 3, which shows what the variable load governor will do.

Construction.

Fig. 4 illustrates the latest type "Mirrlees-Diesel" oil engine, built by Mirrlees, Bickerton & Day, Stockport, for whom the Canadian Boving Co., Toronto, are agents. Most companies manufacturing the Diesel build them vertical, so this serves as an example of them all. Fig. 5 shows a sectional view, as originally constructed, the air compressor, which is now driven direct from the shaft, as shown, was built on the side of the machine, and operated by means of a rocking lever connected by a link to the main lever, but as this introduced side strains and involved the use of many small wearing parts, the practice was discontinued.

As will be noticed all the valves are placed on top of the cylinder, minimizing clearance space. The inlet and exhaust valves are of the usual "mushroom" pattern, operated by cams, the seat and all being made removable, avoiding the necessity of leaving the engine idle, while grinding in the valve. A spare valve and valve seat, supplied with the engine obviates all this. The removal of the valves is facilitated by the levers being so constructed that one half can be easily swung back.

The fuel to be injected into the cylinder is pumped into a receptacle on the cylinder cover, by means of an ordinary plunger pump, the quantity pumped being decided by the governor. If the load on the engine increases, the speed falls slightly and the governor weights move inward, and in so doing, by means of special mechanism, cause the fuel pump to deliver an increased quantity of oil to the cylinder, thus giving more power to meet the load. In a similar manner, increases in load are met. The regulation of the quantity of oil pumped is effected very simply, as shown by reference to Fig. 6. The governor holds up the suction valve of the pump during part of the stroke according to the load on the engine. The Mirrlees-Diesel supplies a pump for each cylinder, while other manufacturers make the one pump answer for them all. This latter system does not give as good distribution.

Fig. 7 shows the valve arrangement. The chamber or receptacle into which the fuel is pumped is connected with the compressed air supply, the pressure of which exceeds the highest pressure obtained in the engine cylinder. From this chamber there is an outlet leading into the cylinder, controlled by a small valve, the fuel valve. Just above this device is a small valve called the "pulveriser," into a chamber above which the oil is delivered with the result that when the fuel valve is opened the oil is forced in by compressed air through the pulveriser into the cylinder, which it enters in the form of a fine spray. Experience shows that a pulveriser suitable for residual petroleum oils which are very viscous, will also suit for less sticky oils, thus requiring but one pulveriser

Starting is obtained by means of compressed air, for the cylinder is fitted with an extra valve, called a starting valve. This starting valve, like the other valves, is operated by a cam, and an arrangement is fitted to the engine, whereby it is impossible for the starting valve and fuel valve to be in operation at the same time.

Economy.

From the viewpoint of fuel economy, the Diesel ranks very high, one feature being that the economy varies but little with the size of engine. From a theoretical standpoint, it is obtaining a very high perfection, as a thermal efficiency as great as 41 per cent. is practicable.

In conclusion, very low operating costs are the rule, for at full load a fuel consumption of .45 pounds is guaranteed, and .70 pounds at ¼ load.

In addition, the standby losses are nothing, as absolutely no fuel is in use when the engine is not in operation, thus introducing a considerable saving.

REPAIRING CYLINDERS BY OXY-ACETLENE.

An example of repairing cylinders by oxy-acetylene welding is shown in the accompanying illustrations. The work was done at Chas. Potter's, 85 Yonge St., Toronto, where a Linde oxy-acetylene welding outfit has been installed.

Fig. 1 shows a broken cylinder of a 4-cylinder Toronto taxicab. The required cylinders are shown in Fig. 2. The water jacket was broken out, the broken pieces resting on the top of Fig. 1. The cylinder was pre-heated so that no strains would be set up afterwards.

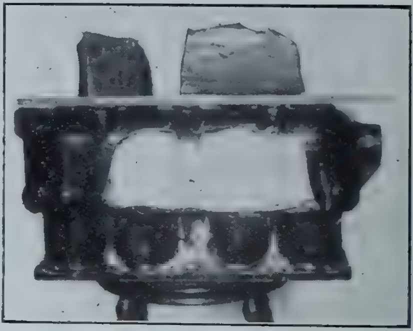


Fig. 1.—Broken Taxicab Cylinder.

The pre-heating is accomplished in an oven lined with fine brick and asbestos. The oxy-acetylene blowpipe (Fouche's patent), is a low pressure blowpipe, constructed on the injector principle and is designed and proportioned to meet all the special conditions with which an oxy-acetylene blowpipe must comply. It is so constructed that the flame cannot strike back. The gases are well mixed in the injector chamber before they issue from the nozzle of the blowpipe and the nozzle itself is so constructed that the possibility of carbonaceous deposit in the orifice is practically obviated.

Among the things that can be repaired economically by oxy-acetylene welding are gas engine cylinders, automobile parts, gears, valves, pulleys, etc. The repair is made at much less cost than making a new part if the new part is expensive. The repair, as far as can be learned from available figures, seldom costs over one-third of the first cost of the casting and usually much less. On small castings the percentage is much larger than on larger ones. On small repairs to large cylinders, etc., the percentage is very low.

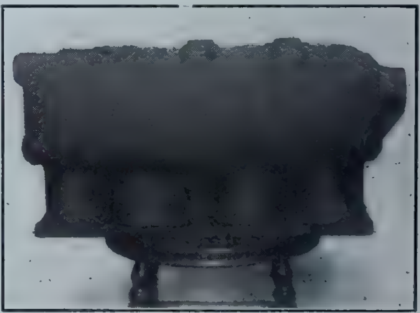


Fig. 2.--Repaired Taxicab Cylinder.

Do not close the damper entirely when there is fire on the grates, as gas may collect and result in an explosion as destructive as if caused by steam.

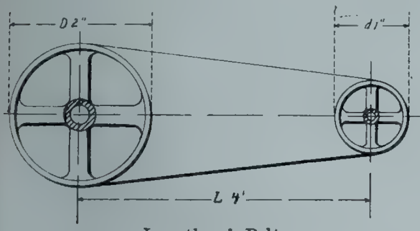
PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

LENGTH OF BELT.

By S. H. W., Sackville.

A simple method of finding the required length of belt for open-running pulleys not in position can be approximately obtained thus, where:



Length of Belt.

D=dia. of the large pulley in ins.
d=dia. of the small pulley in ins.
L=distance between shafts in ins.
B=length of belt in ins.

$$B=3\tfrac{1}{4}\left(\frac{Dd}{2}\right)+2L=12.875 \text{ ins., or } 12\tfrac{7}{8} \text{ ins.}$$

POINTS ON GAUGE GLASSES.

By James E. Noble.

Some engineers swear by cotton wick to pack gauge glasses, others use asbestos wick. I was placed in charge of a plant some time ago and found all the glasses packed as described above. Upon removing the old packing and replacing with rubber washers, the breakages were reduced about half.

To get a tight joint with asbestos or cotton wick, quite a lot of pressure must be put upon the nut and glass, thus leaving very little latitude for expansion of the glass.

A more equal strain can be secured with the rubber and need not be put up very tight as it will take up, even if it leaks, a little at the start, and even if it is put up fairly tight there is abundance of room for expansion. With cotton, asbestos or hemp packing, a leak is liable to occur when things cool down as they have not the elastic force of rubber, and therefore contraction causes the glass and packing to recede from each other. A first-class glass costs more than the seconds, but it costs less in the end.

A small piece of broken glass left in the gland is apt to break the new glass when tightening the gland. After removing an old glass it is good practice to open the gauge cocks and blow steam and water through them to clean out any dirt or foreign matter. Steam should be blown through a new glass for a few seconds to warm it up before opening the bottom gauge cock. The drip cock should always be left open when putting in a new glass. Cases are on record where engineers have had their eyes and faces damaged by new glasses bursting when they were putting them in, they failed to open the glass drain cock and the gauge cocks leaked a little and enough pressure accumulated to burst the glass, which probably had some defect. Again, accidents have often occurred by turning the pressure on to a new glass suddenly. Always run it through the drip first. A new glass tempered for a few minutes in a pail of hot water often saves a glass as it appears to toughen it. You should tighten the nuts up carefully; when they are just firm, open the steam cock for a few seconds, then close the drain cock and open the bottom cock. Make sure that the cocks are exactly in line; one thirty-second of an inch out might cause many breaks as it would be quite possible for the glass to be in contact with the packing nut. Filling the boiler away up and then allowing it to drop near the bottom of the glass will often cause breakages, especially so in places where a draft is liable to strike the glass. Don't allow the glass to turn when putting in new washers. Hold it with your hand. To sum up, very little trouble will be had with water glasses, if good judgment is used in caring for them.

UNDERLOADED ENGINES.

By R. McLaren.

We hear a good deal about overloaded engines, but very little about underloaded engines. And yet it is possible that an underloaded engine can get away with a good deal of coal. One authority makes the following statements about a simple non-condensing engine running with an initial pressure of 80 lbs. gage:

At 5 per cent. cut off the indicator accounts for 58 per cent. of the feed water, that is there is 42 per cent. of the steam lost by cylinder condensation.

At 10 per cent. cut off there is 66 per cent. of the feed water accounted for, making the condensation loss 34 per cent.

At 20 per cent. cut off, 74 per cent. is accounted for and the condensation loss equals 26 per cent.

At 30 per cent. cut off, the figures are 78 per cent. and 22 per cent., and at 50 per cent. cut off they are 86 per cent. and 14 per cent.

The same authority states that under the conditions stated above the actual water consumption of an engine at 10 per cent. cut off=29.88 lbs., at 20 per cent. cut off, 25.68 lbs., at 30 per cent. cut off, 26.29 lbs., and at 50 per cent. cut off, 28.38 lbs.

At 10 per cent. cut off the mean effective pressure=16.07 lbs., at 20 per cent. cut off, 32.02 lbs., at 30 per cent. cut off 43.97 lbs. and at 50 per cent. cut off, 60.44 lbs.

At 50 per cent. cut off it is evident that an engine will do nearly four times as much work as it will do at 10 per cent. cut off.

This means that at 50 per cent. cut off an engine will do the same amount of work that one about four times the size will do at 10 per cent. cut off.

Whether an engine cuts off at 10 per cent. or 50 per cent. its strength must be the same as the initial pressure is the same, the only difference being that the pressure is maintained for a longer time, increasing the tendency to heat at the bearings.

The above figures would indicate that an underloaded engine is an expensive machine to operate.

In a case with which I am acquainted, two engines were running underloaded. By an arrangement of the drives the load was put onto one of them and a saving of considerably over 1,500 lbs. of coal per day was effected.

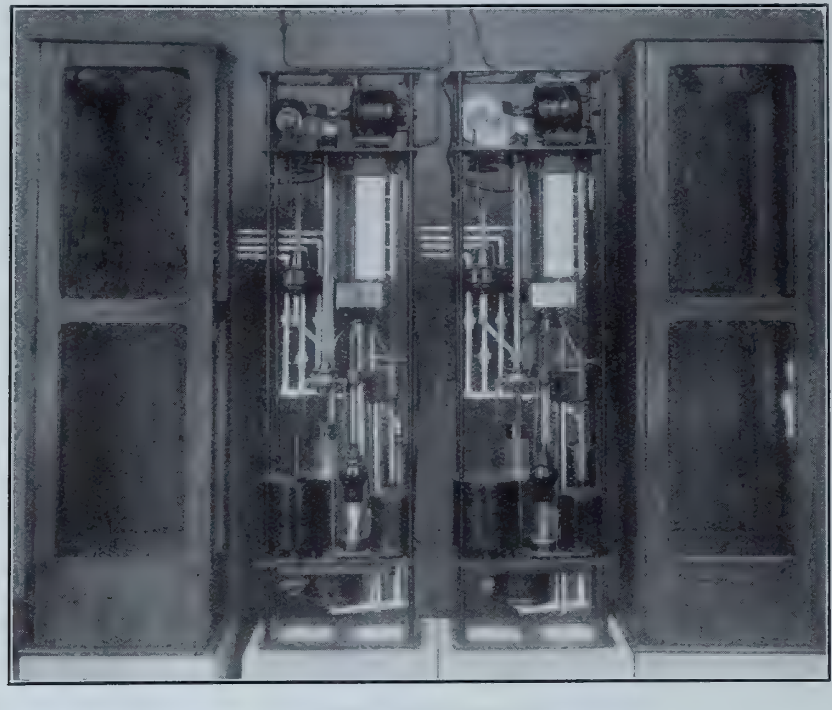
CARBON DIOXIDE RECORDERS.

By Frank C. Perkins.

The accompanying illustration shows a form of automatic Co_2 recorder which will be of interest to fuel consumers and engineers, who have for the last three years witnessed an unparalleled amount of interest in the subject of furnace control and fuel economy. It is held that this interest has been aroused largely by the introduction of the Co_2 recorder and the active educational propaganda therewith.

Every engineer knows he cannot burn coal without its resultant gas and that the quality of this gas is the unerring—the never-failing tell-tale of the quality (economy) of the combustion, and that the only way to tell the quality of the gas, and incidentally, the quality of the combustion that produced it, is by simple analysis, which is exactly the automatic function of the recorder.

It is considered absolutely necessary to conduct all commercial combustion under the guidance of a recorder, if even only fair economy is aimed at, or to state over and over again that savings of 10 and 20 per cent. have been effected by its use, or to point out that the recorder's cost is the merest bagatelle compared with the instant benefits derived from its application to the furnaces. Every fuel user and engineer now fully recognizes the recorder's great value in the boiler room, and its close relation to dividends.



Carbon Dioxide Recorder.

In many recorders the volume of the caustic potash solution is used, as the "yard-stick" with which to measure the volume of the residual gas left over and not absorbed by the potash. This being the case, it will be readily admitted that any change in the volume of the potash solution will result in a corresponding error in the readings or records of the Co_2 gas. The fact that the flue gas almost invariably contains moisture, which condenses and stays in the potash solution, means the constant necessity for readjustments. This is just what happens in practice and amounts to daily, semi-daily, and in some cases, hourly adjustments with such recorders in stations where correct records are demanded.

It is held by many engineers that in such type of recorder there is also the constant menace of the potash crystalizing and clinging to the balanced parts that move up and down and make the record, thus throwing them out of balance, and the recording pen into corresponding error. The unavoidable variations in temperature to which every Co_2 recorder is subject supplies another disturbing variant in machines where the volume of the potash solution is relied upon for measuring the volume of the gas.

It is claimed that in the recorder illustrated all possibility of error from any of these variants or unmechanical arrangements is completely done away with by the simple expedient of not using and not requiring to use the caustic potash solution for measuring the Co_2 gas.

With this electric Co_2 recorder in the series of events, including the taking of the sample of gas, measuring it, forcing it into contact with the potash solution to the measuring of the residual part of the charge, all are carried out by tooth-gear movements so connected and related that no event can take place out of its proper order or turn. These are operated by a small standard electric motor.

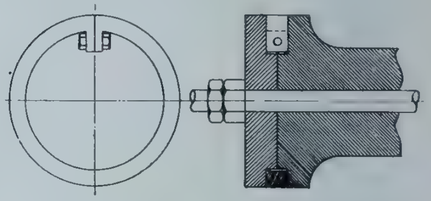
It will be noted that the records are made by electric contact. The two contacts (platinum) are part of two separate floats. These floats are an integral part of the vertically-moving water, so far as the levels are concerned. When the levels meet, as in the standard Orsat, the electric contacts on the floats come together, closing the electric circuit, this in turn making the record. The instant before the levels meet, the floats not being in contact, every part is perfectly free and no friction is interposed to cause inaccuracy in the records, such, for instance, as the dragging of a pen on paper, as in other recorders.

It may be stated that exactly at the instant at which the levels meet and close the circuit, an outside force (the electric current) comes into play to do the actual work of recording. Indeed, the machine is free from all sensitive parts, hence our guarantee of ½ of 1 per cent, accurate in regular working. To insure each charge being a true sample of the gas as it existed in the furnace a few seconds before, only two charges in seven are used for analysis, the rest being automatically rejected after being used for driving out the previous charge.

ADJUSTABLE PISTON VALVE RING.

The engine at the McLachlin Mills, Arnprior, has a piston valve, made by the engineer, Geo. H. Johnson, which is worthy of notice, from the fact that precautions have been taken to look after the natural wear.

The piston valve, a section of half of which is shown in the cut, consists of three sections—the body and two end pieces, the latter, with the main body, forming the annular grooves for the piston valve rings. This ring is unique in construction, as shown by the end view, as it consists of a single piece, bolted together at the top, the bolt flange fitting into a similar recess in the piston valve.



Piston Valve Ring.

The idea of the split and bolted construction is, that the ring, after becoming slightly worn, may have paper or tin shims placed in the cut, and clamped in position, the ring then assuming a practically circular form again. Satisfactory operation seems to have resulted from its use.

H.P. OF CAST IRON GEARS.

F=breadth, or face of tooth in inches
T=thickness of tooth at pitch line, inches.
V=velocity at pitch line in feet per minute.
L=length of tooth, from root to point, in inches.
C=constant.
HP=horse power transmitted with a safety of seven; ultimate tensile strength 25,000 lbs. per square inch.

(1) Horse power of spur gears=

$$\frac{F \times T^2 \times V}{L \times 53}$$

(2) Horse power of bevel gears=

$$\frac{F \times T^2 \times V}{L \times 77}$$

(3) Horse power of mitre gears=

$$\frac{F \times T^2 \times V}{L \times 82}$$

In formulae 2 and 3 for bevel and mitre gears the factors T and L express the pitch at large end of tooth.

Horse Power of Head Shafts

$$D = \sqrt[3]{\frac{100 \times H}{R}} \qquad H = \frac{D^3 \times R}{100}$$

Diameter of Shaft in Inches	Number of Revolutions Per Minute							
	25	50	100	200	300	400	500	600
$1\frac{7}{16}$	.85	1.7	3.4	6.8	10.2	13.6	17.	20.4
$1\frac{11}{16}$	1.35	2.7	5.4	10.8	16.2	21.6	27.	32.4
$1\frac{15}{16}$	2.	4.	8.	16.	24.	32.	40.	48.
$2\frac{3}{16}$	2.8	5.7	11.4	22.8	34.2	45.6	57.	68.4
$2\frac{7}{16}$	3.9	7.8	15.6	31.2	46.8	62.4	78.	93.6
$2\frac{11}{16}$	5.2	10.5	21.	42.	63.	84.	105.	126.
$2\frac{15}{16}$	6.7	13.5	27.	54.	81.	108.	135.	162.
$3\frac{3}{16}$	8.5	17.	34.	68.	102.	136.	170.	204.
$3\frac{7}{16}$	10.7	21.5	43.	86.	129.	172.	215.	258.
$3\frac{15}{16}$	16.	32.	64.	128.	192.	256.	320.	384.
$4\frac{7}{16}$	22.7	45.5	91.	182.	273.	364.	455.	546.
$4\frac{15}{16}$	31.2	62.5	125.	250.	375.	500.	625.	750.
$5\frac{7}{16}$	41.5	83.1	166.3	332.6	499.	665.	831.	998.
$5\frac{15}{16}$	54.	108.	216.	432.	648.	864.	1080.	1296.
6½	68.6	137.2	274.4	548.8	823.2	1097.6	1372.	1646.4
7	85.75	171.5	343.	686.	1029.	1372.	1715.	2058.
7½	105.4	210.8	421.6	843.2	1264.8	1686.2	2108.	2529.6
8	128.	256.	512.	1024.	1536.	2048.	2560.	3072.
9	182.35	364.5	729.	1458.	2187.	2916.	3645.	4374.
10	250.	500.	1000.	2000.	3000.	4000.	5000.	6000.

Horse Power of Line Shafts

$$D = \sqrt[3]{\frac{75 \times H}{R}} \qquad H = \frac{D^3 \times R}{75}$$

Diameter of Shaft in Inches	Number of Revolutions Per Minute							
	25	50	100	200	300	400	500	600
$1\frac{7}{16}$	1.1	2.2	4.4	8.8	13.2	17.6	22.	26.4
$1\frac{11}{16}$	1.8	3.6	7.2	14.4	21.6	28.8	36.	43.2
$1\frac{15}{16}$	2.7	5.4	10.8	21.6	32.4	43.2	54.	64.8
$2\frac{3}{16}$	3.7	7.4	14.8	29.6	44.4	59.2	74.	88.8
$2\frac{7}{16}$	5.2	10.4	20.8	41.6	62.4	83.2	104.	124.8
$2\frac{11}{16}$	6.9	13.8	27.6	55.2	82.8	110.4	138.	165.6
$2\frac{15}{16}$	8.9	17.8	35.6	71.2	106.8	142.4	178.	213.6
$3\frac{3}{16}$	11.3	22.6	45.2	90.4	135.6	180.8	226.	271.2
$3\frac{7}{16}$	14.2	28.4	56.8	113.6	170.4	227.2	284.	340.8
$3\frac{15}{16}$	21.3	42.6	85.2	170.4	255.6	340.8	426.	511.2
$4\frac{7}{16}$	30.2	60.4	120.8	241.6	362.4	483.2	604.	724.8
$4\frac{15}{16}$	41.6	83.2	166.4	332.8	499.2	665.6	832.	998.4
$5\frac{7}{16}$	55.3	110.6	221.2	442.4	663.6	884.8	1106.	1327.2
$5\frac{15}{16}$	72.	144.	288.	576.	864.	1152.	1440.	1728.

H=Horsepower. D=Diameter of shaft. R=Revolutions per minute.

For bevel and mitre, thickness and length of teeth have been computed at centre of face. With a view, however, of facilitating calculation, the proportions of factors T and L in formulae (2) and (3) have been taken at large end of tooth, thus giving same dimensions as for spur gears; hence the spur gear formulae has been utilized, with the exception of the constant, which has been determined by averaging the proportions of the teeth of bevel and mitre gears having the largest and smallest number of teeth in general use. The resultant horse power is consequently less than in the case of spur gears of like pitch.

For mortise wheels and pinions use thickness of pinion tooth. If different factor of safety is desired, multiply above result by 7 and divide by factor of safety desired.

The Hill Clutch Co., Cleveland, recommend the following speeds in feet per minute as the maximum at which, under favorable conditions, it is safe to run toothed gears.

	Ft. per Min.
Molded cast iron gears	1,500
Helical cast iron gears	2,000
Mortise cast iron gears	2,000
Molded cast steel gears	2,200
Helical cast steel gears	2,500
Machine cut cast iron gears.....	2,500
Machine cut cast steel gears.....	3,000

Although the above are conservative limits for safety, it is generally necessary to keep the speed much lower to avoid excessive noise and wear.

The two accompanying tables giving the horse power of head shafts and the horse power of line shafts were also prepared by the Hill Clutch Co.

SHELBY STEEL TUBES.

An interesting catalogue of Shelby Steel Tubes has been issued by John Millen & Son, 321 St. James St., Montreal, in which the manufacture of steel tubes for various purposes is fully described as well as their applications.

Another part of the catalogue is devoted to Hoffman Steel Balls and their application to bearings. Coventry chains forms another interesting chapter.

The remainder of the catalogue of 150 pages contains valuable data on hoists, trolleys, steel poles, railway supplies, including trolleys, headlights, etc. This catalogue will be sent free to any address on request.

Compressed air for cleaning the electric machinery in all parts of the filtration building of the Cincinnati water purification works has been made available by the instalation of a motor-driven compressor and a small air receiver in the pump room of the head-house. From the receiver a 1-in. pipe line, with suitable outlets, was run through the pipe gallery of the filter house and into the chemical house. A flexible hose attached to outlets on the line permits the electric equipment to be cleaned readily.

A novel lightning arrester for telegraph and telephone train dispatching circuits has recently been devised. In place of using an air gap, a block of carborundum is employed, which furnishes enough resistance to prevent leakage of the current under normal conditions, but allows charges induced by lightning to pass freely to the ground. These lightning arresters have been found to prevent the clicks commonly produced by static charges.

Walter Amos, B.A., Sc., has severed his connection with the electrical department of Toronto, and is now with Smith, Kerry and Chace, in their Toronto office.

Mr. Flanagan, B.A., Sc., has gone west for C. H. Mitchell, C.E.

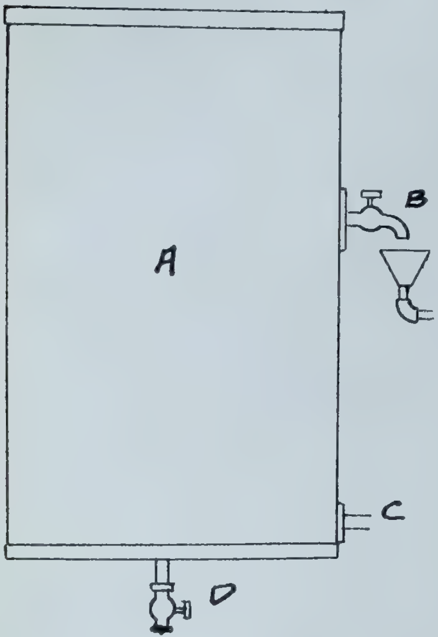
Correspondence

Discussion on Previous Articles
Remuneration for Useful Ideas

SECOND USE OF OIL.

Replying to Mr. Ivie's question I would suggest the following treatment for his recovered oil:

Boil it up again with water, by low pressure steam, if obtainable. I would not recommend more than twenty pounds pressure, and allow it to cool slowly. I am having a boiling tank made for my plant to clean crank case oil, and the same could be used for cylinder oil.



Tank for Purifying Oil.

A is a galvanized iron tank (mine holds about twenty-five gallons), B is a draw-off cock for the washed oil. E is a cold or warm water inlet, (warm by preference), and D is a waste cock. To clean the oil put about ten gallons of it in the tank, add about six or seven gallons of water and turn on the steam. Let it boil gently, about eight hours and then stop the steam and cover the tank well, so that it cools slowly. The washed oil may be run off at B. If the oil level falls below B admit warm water at C, not to fast or it will stir the oil up.

As Mr. Ivie only uses oil of 620 fire test, there will be no fear of it not being good enough to stand steam at 387 degrees or thereabouts, especially when it is remembered that in process of manufacture the oil is heated to a temperature of about 800 degrees. As to whether more will be needed, that is an open question. I should imagine Mr. Ivie will not be many days finding that point out. As I was an oil refiner before I became an engineer, I can safely recommend this method.—Second Engineer.

BOILER STAY QUESTION.

I should like to have the correct answer to this question from some of the readers of The Power House:

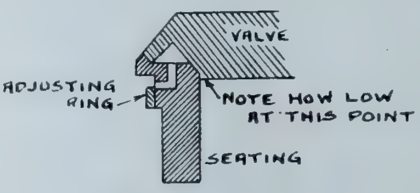
The upper segments of the heads of a return tubular boiler are stayed by longitudinal through stays, double nutted, diameter 1⅞'', area at root of thread 2.051 square inches. The outer nuts are screwed up, producing a total stress of 10,250 lbs. in the body of the stay, the inner nuts are then tightened, producing a stress of 14,200 lbs. in that part of the stay, between the inner and outer nuts.

When the boiler is steamed up to 135 lbs. pressure, what will be the stress (a) in the body of the stay; (b) in that part between the inner and outer nuts?

The stays each support 100 square inches area of plate.—"Boiler Stay."

SAFETY VALVE TROUBLE.

I have read the few solutions to Mr. E. V. Morel's trouble. None of them I think would fix it as the blow back is so much. I once had a 3 inch safety valve that blew back about 13 lbs. The trouble with this one was that the valve had been badly eaten away and allowed the valve to go down into the seating, so that in the sense it acted like a piston, and had to raise about 1-16 inch before any steam would escape. I had the lip turned off, the result was a fall of about 4 to 5 pounds before closing.



Safety Valve Trouble.

The way I found out that trouble was by just giving the valve stem a light tap with the hand when the steam had fallen 6 lbs. and the spindle would fall about 1-16 inch.

I think that the above is, perhaps, a more correct solution to Mr. Morel's trouble.—C. Henry Watson.

LEAKY VALVES.

In the July issue of The Power House, page 56, a set of indicator diagrams is submitted by A. F. Moray, along with the question "Does the card show leaky valves?"

At the best, this is a very unsatisfactory way of ascertaining whether or not the valves of an engine leak. In the first place, the admission valves may leak considerably, and yet not show it on the expansion curve to any extent if the exhaust valves also leak at about the same rate. The shape of the expansion curve could also be very misleading if the piston rings were worn loose and leaked instead of the exhaust valves.

The actual expansion curve on a diagram usually falls a little below the isothermal curve during the first part of the stroke and rises above it during the latter part; this, because steam is not a perfect gas. However, if it is presumed that the piston and exhaust valves of Mr. Moray's engine are not leaking, then it is pretty safe to say that, according to the card shown, the admission valves are in good shape.

Before the expansion line on the diagrams could be compared with the theoretical curve, it was necessary to plot both the vacuum and clearance lines. As Mr. Moray neglected to include either the atmospheric or vacuum lines in his card, the position of the latter could only be estimated from the "25 inch vacuum carried."

By the well-known rectangle method I found the clearance to be approximately 0.03 per cent., and think this would be pretty close to the right amount for an engine of the given type.

The diagrams show the engine to be somewhat unbalanced, as the M.E.P. for one end is about 35.5 lbs., and for the other end about 40 lbs. Taking a mean pressure of, say, 38 lbs., the horsepower developed at 90 r.p.m. would be 104 in round numbers.—J. A. Carruthers.

ENGINEERS' CERTIFICATES.

The editorial on the above subject in the September number may prove a little misleading (as regards Alberta) to engineers coming into this province. However, the uniform license law advocated is a timely and interesting topic to all Canadian engineers—or, at least, should be.

When an applicant for a certificate in Alberta reaches the province, it is not necessary for him to rush off immediately to Edmonton to get busy writing on an exam. There are six or eight government boiler inspectors having headquarters at as many different towns and cities throughout the province, and any one of them are only too glad to give an applicant a chance to "deliver the goods" on a regular examination date, provided the said applicant can produce proof of practical experience required. I have not yet heard of a case where a new engineer was debarred from operating without a license until such time as the next regular examination date came round, if he took the trouble to report to the inspector of the district either by mail or in in person before starting on his new duties. Our inspectors in Alberta are not political heelers, but practical men who have been either operating engineers or boiler-makers before taking their present positions; therefore, they have a good working knowledge of the troubles a new engineer has to overcome or get used to, and hence they are not simply lying in wait to prosecute or persecute him.

Quoting from the editorial referred to: "Alberta has now refused to recognize an Ontario certificate, so that an Ontario engineer who moves ta Alberta must journey to Edmonton and write, at once, the examination prescribed for engineers in that province. This is very harsh treatment and seems to us, in view of the amendment added by the Ontario Government, a retrograde step, which may result in cancelling the privilege of an Ontario provisional certificate as far as Alberta is concerned."

Now, it is perfectly true that there is "harsh treatment" dealt out in Alberta, but it is only to those would-be-engineers who spend a lot of time dodging the inspectors and explaining the details of the huge plants they used to have charge (?) of "back east" or "in the States."

As far as the "retrograde step" is concerned, I think there is a lot of room for argument; to my mind, after a close study of the license laws in both British Columbia and Alberta, it is a great step towards a higher standard in the craft. As the editorial states, the object of the licensed engineer is primarily a measure for public safety. Well, at the present time in Manitoba and Ontario the qualifications necessary to legally call oneself an engineer are so microscopically small that the inspectors of Alberta cannot see them with the naked eye. For instance, consider Art. 8 of the Steam Engineers' Act of Manitoba: "All engineers now in charge of a steam plant, and who have been in charge of such plant two years or more, shall be granted a certificate without examination for their plant, or any other plant of the same capacity, by paying the regular fees." If anyone takes the trouble to compare this qualification with any of the qualifications for any of the grades of certificates in Alberta or British Columbia, he will see at once that there is a big difference in "the engineer in the making" down in the cultured east and out in the wooly west. It is a well known fact that there are lots of employers, especially in the provinces having a very lax license law, or none at all, who believe in hiring an engineer (?) that can simply throw coal and oil into their respective places. If the enaineer gets balled up when the feed pump hangs up or the injector bucks and has to shut down the plant; or if he runs a close shave to blowing up the boilers by trying to make the pump work after the water level has got down to the danger mark, the boss consoles himself with the thought of how little the engineer costs him in wages, and how economical is his engineer in the matter of steam, as proved by the fact of his placing a piece of 2x4 between the roof and the safety valve lever to keep it from "sizzling."

Now, while there are a lot of good men who would be entitled to their certificate without an exam., there are also a lot of bluffers and fakirs who hold this job for a while (until the plant gets run down at the heel) through "pull," or, as in the case described above, through their willingness to pose as an engineer for laborer's wages.

A uniform license law for the Dominion would be a good thing, but the eastern portion of the country is not yet ready to get into the game. It takes time to develop a fair to satisfactory license law in any place, so as not to cause a "hold-up" upon either employers or engineers. At the present time this would certainly be the case in Ontario or Manitoba.

There is one thing I believe the engineers of the two most western provinces will unite in doing, and that is to back up the inspector's contention that the standard of the exams. be not reduced in the west.

When the license laws of the eastern provinces require their engineers to know as much about the making, repairing and operating of steam boilers and engines, as do the laws of British Columbia and Alberta, then they will find the greatest obstacle to a uniform law removed.

There is another factor in the problem that cannot be sidetracked, and that is the time-worn view-point of human nature. Some will say that public safety is the only reason for a license law, and they are right of course; but it will be found that 99 per cent. of the engineers who have "made good" under strict qualifications like those of the British Board of Trade, for instance, will look at the question from a bread and butter standpoint.

Take, for example, an engineer that has secured his "first" in Alberta after serving two years in a machine shop working on boilers or engines and having had charge of a 300 horsepower plant at least a year; or that of a first-class man in British Columbia who has had to have charge of a 300 horsepower plant at least for five years, or else show at least seven years' service in an engine and boiler building shop if he has not had charge of a 300 horsepower plant at any time—candidly, is it probable that a man who has worked up through all the steps necessary in securing such practical experience will look with favor upon a measure to place his services on the open market in competition with others who have practically been presented with their certificates? It must also be remembered that the engineer in question who has had to secure so many years of practical experience must also have spent considerable time in study. This man is not going to encourage a movement towards an easier entrance to the craft, thus letting a lot of men in that know little and care less about their work.

As regards the question of fees for certificates it will be found by all, except those who are only in the business a short while to make a stake, that it is cheaper to pay the one initial fee of say $5 as in the west, than to pay a yearly fee of $1 for renewal, as is the custom in some provinces. And, as the editorial advocates, these fees should be paid out of the public tax receipts.

The foregoing remarks will probably bring out some criticism, adverse and otherwise; and this is to be desired, as a question approached from different angles will result in a better understanding to all concerned.

We will, therefore, hope that The Power House editor will deal gently with all who wish to put a spoke in the wheel.—J. A. Carruthers.

CONDENSING WATER.

In the September issue of The Power House the following correction should be made: If the temperature of water supplied to the condenser is 55 to 60 degrees Fahr. and the temperature of overflow or outlet is 85 to 90 degrees Fahr., the quantity of water that will be required will be about 0.9 gal. per min. per 24 hour ton of ice. This should read about 2.9 gals. per 24 hour ton of ice.—W. G. Walters.

ELECTRICITY FOR STATIONARY ENGINEERS

HOLES IN COMMUTATORS.

By R. McLaren.

A trouble which is not so very uncommon, is holes in commutators, that is, eating away of the insulation between the commutator bars. If we look in the text-books for a remedy we will likely get fooled for there is mighty little information there on the subject. One firm of manufacturers in their instruction books, names several remedies, such as a paste of plaster of Paris and shellac, pressed into the hole after first cleaning the hole thoroughly of any charred material—carbon being a conductor of electricity, a paste of litharge and glycerine, applied in the same way, and a paste of powdered glass and water glass also applied in the same way. I have not tried the last method, but the first two I tried till I was good and tired. Sometimes they would last for a day, sometimes for a couple of weeks, but never long enough to be forgotten.

At last I decided to try the plaster of Paris dry and rammed well into the hole, to near the surface of the commutator, finishing with a paste of shellac and plaster of Paris. Several months have now passed since the application of this remedy without any sign of trouble, so I guess it may now be listed as a remedy for holes in commutators.

INCIDENTS IN CENTRAL STATION PRACTICE.

By J. A. S., Newcastle.

Another incident in addition to those mentioned in the August issue of The Power House occurred on the main generator of a power house, and was found at the electrical end of a combined set. The machine had, through constant running, developed flats and grooves in the commutator, and it was decided that this should be turned down. Unfortunately the fitter on the job took too deep a cut, and this carelessness in turning down the commutator caused considerable trouble.

The mica separation between the adjacent segments was split and broken, and this was not noticed until the armature had been put back again into position. After a short run, however, when the machine was on load, the brushes suddenly sparked violently and flashed right across, with the results that, if the machine had not been taken out promptly and the load changed over to other generators, there would have been a shut down of supply. On examination it was found that owing to the absence of the mica separation the crevices between the commutator segments had become filled with copper dust from the surface of the bars, causing a continuous circuit to pass from brush to brush, with the result of the heavy flash over.

In another case considerable trouble was caused on a direct current generator, not because of any fault of the commutator, but because sufficient care had not been taken in adjusting the pressure of the brushes. The generator affected was a 550 volt traction machine with a very wide commutator and a large number of brushes on each collector arm, and after cleaning up the commutator and setting the machine to work again the attendant omitted to adjust the brush pressures. The result was that some of these brushes worked loose and the current density on the remaining brushes increased to such a dangerous extent that undue sparking took place. The result was that the commutator was very severely damaged and the machine was for a time put out of action until the matter could be thoroughly attended to. Sparking of this nature may also be very easily caused by the fact that the brushes are unequally spaced, and a good many dynamo attendants are not aware of importance of this fact. In one case, after the machine had been running several days sparking developed and became worse and worse. The commutator became blackened and pitted. The first thing that occurred to the engineer in charge was that there was something wrong with either the field or the armature, and these were tested for continuity and insulation, but finally he discovered that the machine had recently had its brushes trimmed and reset. This particular machine was a rather old exciting plant of the two-pole type and was being run with gauze brushes. On counting the armature segments between each brush there was shown unequal spacing. It was therefore necessary to glass paper the commutator and finish it off with fine emery. The brushes were trimmed and reset by the engineer, and in order to prevent any similar trouble in future "pop" marks were made with a centre punch on the commutator binding rings, and the brushes were afterwards always set to these. It is fortunate that the cause of this trouble was caught in time as a shut down on the exciter set would probably have meant a very serious stop in the station.

Recent Power Developments at Niagara Falls

Additions to the Various Plants in Operation at Niagara Falls That have Occurred Since the Initial Installations of the Stations.

NIAGARA Falls and power development seem to be synonymous terms so intimately connected are the two words from the fact that the Niagara Falls power plants have become so world famous from the stupendous nature of the different power undertakings.

Their world-wide fame is testified by the number of questions with which every engineer from America, is plied, when visiting hydro-electric installations in Europe. The European engineer considers that, as a matter of course, the engineer from this continent must be very conversant with the extent of the power works, which to him appear to be the acme of power plant development, both in the matter of size and design.

Since the plants were originally built various improvements and additions have been made, for the Niagara Falls Power Co. on the United States side, is the only one of all the plants that has its power allotment fully harnessed.

Ontario Power Co.

The general design of this plant differs materially from all the other plants at the Falls. The power plant proper, is located below the Falls, and water is brought from the head works about a mile and a quarter above, through large conduits.

The ultimate development will be 180,000 h.p. for which three conduits will be required, but as originally built only one of these was installed. At present the various additions necessitate the building of a second, which will later be followed by the third.

The intake of reinforced concrete, was

built of sufficient size originally, to handle the full capacity of plant. This also applies to outer forebay, screen house, inner forebay, and gate house. Thus the headworks are complete. The one conduit first installed was circular in form, 18 feet diameter, and built of half inch steel plate, with stiffening rings half way around the top, and the whole encased in concrete. The one conduit alone is sufficient to more then supply six generators at full load.

The second conduit, which has just been completed comes from the second gate in the gate house, and differs in design from that of the first pipe, being built wholly of reinforced concrete and is oblate in form, i.e., the form which would be taken by a flexible pipe flatter on the bottom than at the top and has an effective diameter of eighteen feet. The thickness of reinforced concrete is eighteen inches. It is interesting from the fact that it is practically the first application of reinforced concrete to pressure pipe of anything like these dimensions. By-passes at various points between these two pipes, make them of mutual assistance to each other.

The overflow, which was designed originally to handle but one conduit is being made to do service for both, temporarily, until such time as an addition can be made. The present overflow permits of the escapement of the surplus water through a spiral tunnel to the river below.

The original valve chamber which is 274 feet long, 10 feet high, and 16 feet wide is being extended in an essentially similar manner to increase the number of units from seven to ten. The valves are controlled by 30 h.p. induction motors either locally or from the generating station. The additional penstocks are practically the same as the old ones.

The generating station, located directly below the Falls under the cliff, has been extended 132 feet, to make room for the three new units. This plant differs from the others, in that the turbines and generators are horizontally placed instead of vertically, as with all the other plants. At present seven units are in operation, all the electrical equipment being Westinghouse make. The new units which are 12,000 h.p., 187½ r.p.m., 3 phase, 25 cycle, 12,000 volts, are of Canadian General Electric manufacture. The turbines are of the same build as the last from J. M. Voith, Neidenheim a.d. Brenz, Germany, capacity 12,500 h.p under normal head. They are of the inward flow horizontal twin type.

The original cable tunnel has not been changed in any way, but a second similar tunnel is being added, connecting the generating and distributing stations. It is rock-excavated, and lined with concrete, running diagonally up through the cliff. As all the present increase will probably be taken up by the requirements of the Hydro-Electric Commission, who are to take all their power from the Ontario Power Co., an additional cable way of standard type connecting the distributing station with the Hydro-Electric transformer house, has been constructed.

As the company's distributing station was built to accommodate the apparatus for 14 units, no extension to it has been made in connection with the present increase.

Toronto Power Co.

The Toronto Power Co. is next in importance as regards recent developments, for the capacity of the plant is being nearly doubled. This plant is the furthest up the river, some short distance below the head works of the Ontario Power Co.

As originally constructed, provision was made for the placing of ten units, the intake, penstocks, etc., being so constructed. The upper part of the building in which the generators are housed, is only about two-thirds completed. At present from 13,500 h.p., 12,000 volt, 25 cycle, 3 phase, c.s.e. units are in operation, and the addition will take in three similar units of 15,000 h.p. capacity. To meet this addition, a small lean-to from the main building will be necessitated, as the outer unit projects slightly. The new turbines are to be made by the same firm as formerly, the I. P. Morris Co., Philadelphia, and the three additional steel penstocks are of Canada Foundry manufacture. The original construction of the pit for its full allotment of power, leaves everything in readiness for the further installation

The same full capacity policy was exercised regarding the switch board, which is large enough to meet all requirements, necessitating only the installation of the instruments. Similarly, the transformer house requires no extension.

The present exciter is sufficiently large that no addition is required.

New lightning protective apparatus, about which there is considerable secrecy, is being installed, and it is claimed to be as nearly perfect as possible.

Canadian Niagara Power Co.

Comparatively slight changes are being made at the Canadian Niagara Falls Power Co., only one more unit being added, a generator of Canadian Westinghouse manufacture, 12,500 h.p., 25 cycle, 3 phase, 12,000 volt, driven from a turbine designed by C. C. Egbert, engineer for the company, and manufactured for them by the Bethlehem Steel Co. The penstocks are being made by the Jno. Inglis Co., Toronto. As the intake, wheel pit, etc., were completed for the final capacity of the plant, very little work is required, as the new unit only necessitates an addition of 26 feet to the building, which is now about half its final size.

Niagara Falls Power Co.

This is the other plant of the last described company, and is located on the United States side. As it has been in operation for upwards of 20 years, the full allotment of power has been developed, so that now, there are 21 units of 5,000 h.p. each in operation.

This plant affords an example of what developments are occurring in power apparatus. When the first portion of this plant was installed in the early nineties, 5,000 h.p. units were used. As, previous to this, nothing over 1,000 h.p. had ever been made, either in turbines or generators, it can be seen that this was a very radical step. But, now, alongside of 12,500 h.p. units in successful operation at the Falls, they appear quite insignificant.

Hydro-Electric Commission.

The Ontario Government, through the Hydro-Electric Commission, in pursuance of their policy of government distribution of Niagara power, have had to build the necessary transmission station at the Falls, which constitutes one of the most important recent changes there.

This transformer house is about half a mile back from the transmitting station of the Ontario Power Co., from whom all their power is obtained. The building measures approximately 45 ft. by 184 ft., and, as at present constructed, will accommodate half the contemplated final installation. This necessitated the erection of slightly over half the projected building, as the controlling end is complete, with one wing built north from it. A similar wing is to be built at some future date. The present building will accommodate 36,000 k.w.

Power is transmitted at 12,000 volt from the Ontario Power Co.'s transmitting station, through a tunnel, through oil switches in the basement, from which it is led to 3 banks of three 3,000 k.w. transformers delta connected on the low, and star connected on the high. These transformers raise the voltage to 63,000 volts across each phase, and as this high side is star connected, a line voltage of 110,000 volts is produced.

The electrical apparatus, which is all of Westinghouse make, is controlled by a 110 volt direct current line. Lightning difficulties are provided for by lightning arrestors outside the building.

In California it has been demonstrated that in thermal units, two and a half barrels of oil equals one ton of coal. Coal costs there from $6 to $8 per ton wholesale. while the market delivery price of oil is $1 per barrel.

N. S. SOCIETY OF ENGINEERS.

The Nova Scotia Society of Engineers, who met at Halifax recently have elected the following officers for the coming year:—

President—J. W. McKenzie, Halifax.

First-Vice-President—P. A. Freeman, Halifax.

Second-Vice-President—W. G. Yorston, Sydney.

Secretary and Treasurer—J. Lorn Allan, Dartmouth.

District No. 1—Hiram Donkin, A. R. MacCleave, Halifax.

District No. 2—R. W. Mackenzie, D. McD. Campbell, Sydney.

District No. 3—A. G. Robb, Amherst; J. G. Mackenzie, Westville.

District No. 4—L. C. Gelling, Bridgewater; Percy E. Brown, Westville.

Auditors—Harry A. Russell, J. S. Meisner, Dartmouth.

Friday's programme was as follows:—

Reading and discussion of the following papers:—"Water Powers of Nova Scotia," by W. G. Yorston, C.E.; "Recent Developments in Technical Education," by F. H. Sexton, director of technical education, Nova Scotia.

Visit to the following industries: Silliker Car Co., Halifax dry dock, Halifax Tram Company's power house, Nova Scotia Technical College.

Dinner at Birchdale Hotel, Waegwoltic Club band concert.

Water Powers of Nova Scotia.

The paper on "The Water Powers of the Province of Nova Scotia," by W. G. Yorston, C.E., of Pictou, at this morning's session of the N. S. Society of Engineers annual meeting, was a very interesting one and attracted much attention. Mr. Yorston has been connected with the water powers of the province for some time and is an enthusiast on the subject. He believes Nova Scotia's water powers are destined to become of great value in her industrial life and he watches carefully the increasing developments of those powers. While holding those views Mr. Yorston does not attempt to compare them in magnitude with those of sister provinces in the Dominion.

In all parts of the province there are water powers well worth development which have not so far received attention. On other streams development is well advanced, and some few rivers, particularly the Mersey and St. Croix, are at present generating quite an amount of power. Still at the same time not one of the streams has the development of its full power completed.

Steam and Water Together.

So far little or no attention has been given to the use of steam power as an auxilary to water power plants. The chief defect of water power is its great variability. The flow in the dry summer months will be found to be one-tenth and less of the flow in other months when the rain fall is heavier. If steam power were used as an auxilary to supplement the power in the months of small stream flow, the amount of power to be derived could be made much more constant. But the best power of all is one in which storage reservoirs and steam are both used to increase the amount of power, the ideal power being one with reservoir capacity to equalize the flow over not only a year but a cycle of years and thus obliterate the vagaries of the rain fall.

The capacity of the power development of any water power proposition is a problem which requires solving for each individual case.

THROW ON THE LIGHT

YOUR business principles may be right; your goods the best; your service to customers faultless.

BUT THE PUBLIC
HAS GOT TO KNOW

Keep always your talking points before the public. Get in the glare of favorable publicity. Make known the merits of your proposition.

Success comes by focusing the diverging rays of public opinion--centering buyers' choice on what you have to offer.

Make your ability, your commodity, your service KNOWN.

THROW ON THE LIGHT

A factor which enters largely into the case is the cost of development and the annual charges on it as to the saving which can be effected by the use of that amount of water power. If the plant is designed with steam power as auxiliary care must be taken in the calculations to find the point at which the saving by using steam power about equals the fixed charges on the cost of developing the water power, and this will be the limit, beyond which it will not be economical to create power by water.

It must be conceded our streams have a deficiency of storage capacity, and to permit of the highest development artificial storage must be created on the watershed by placing dams across the stream, where possible and create reservoirs to hold back part of the flood flow.

INTERNATIONAL BROTHERHOOD OF STATIONARY ENGINEERS.

A new union, to be known as the International Brotherhood of Stationary Firemen, Stokers, Oilers and Helpers, was organized recently in Winnipeg.

The officers elected were: R. W. Parr, president; W. J. Campbell, vice-president; Harold Hare, recording secretary; Fred Baxter, secretary-treasurer, and J. G. Duncan, chairman of the board of trustees. Mr. Parr was also appointed to the office of business agent and organizer. The new union has decided to hold its meetings weekly, on Wednesday.

Canadian Tungsten Lamp Co.'s Expansion.

The Canadian Tungsten Lamp Co., Hamilton, have just completed a large addition to their plant, more than twice as large as the one completed in 1909. The addition is to accommodate the tungsten lamp department.

The building throughout is a very handsome addition, with large, spacious rooms, and cleanliness both in appearance and effect have been carefully provided for. The laboratory is especially worthy of a visit, panelled throughout with white enamel, which looks almost like a boudoir were it not for the complete equipment of retorts and chemical appliances with which the Canadian Tungsten Lamp Co.'s chemists are continually experimenting, keeping pace with the developments continually being made in electric lighting.

Engineers' Supply Co.

The Engineers' Supply Co., 86 Notre Dame St., Montreal, have been organized with J. L. MacKenzie as manager, to deal in power plant specialties. A number of first class agencies have been secured including such lines as metallic packing, grate bars, soot blowers for water tube boilers, automatic temperature control apparatus, damper regulators, blow-off valves, etc.

Trade Notes.

The Glacier Metal Co., Richmond, Va., are placing on the market a new ribbonized, plastic metallic packing for steam, air, water, gas, ammonia, etc. This packing is manufactured from fine alloy of white metal which can satisfactorily be made into fine shreds or ribbons—is very pliable, shows no corrosion when it comes in contact with acids. A rope can easily be made with the hands of the size required for packing the rods.

Mr. Robson, a representative of The Power House, has just returned from a successful business trip to Detroit, Mich., and other points in the West. While in Detroit Mr. Robson secured an advertising contract from the American Lubricator Co. A. G. Laird, the secretary and general manager of this concern, is an old Chatham resident, and says he will always retain a warm spot in his heart for his old Canadian home. Mr. Robson states that the new factory of the American Lubricator Co. now nearing completion is one of the most modern and up-to-date factories in the country. The products of this company have always been held in high regard by the larger users of the country and their rapidly increasing business has compelled the company to erect this large new building.

The U.S. Indestructible Gasket Co., 50 Church St., New York, are erecting a new plant in Brooklyn, N.Y., for the manufacture of gaskets, washers, etc.

COMPRESSED AIR IN REFRIGERATION.

By W. G. Walters.

In attempting to answer W. Duncombe's question, re compressed air, it will be necessary in order to understand what we are trying to get at to go into the theory of temperature and pressure. In regard to absolute temperature experiments have been proved that all pure dry gases expand very nearly to the same extent for equal increments of heat and it therefore matters little what gas is taken for the purpose of explaining the principle on which the basis for absolute temperature has been determined. Absolute pressure is lbs. per square in. above a vacuum, and as steam gauges are adjusted so that the zero mark represents the atmospheric pressure, it is necessary to add 14.7 to the gauge pressure to convert it into absolute pressure.

Let Fig. 1 represent a cylinder with a cross-sectional area of 144 sq. in. (1 sq. ft.) tightly closed at both ends and fitted with a piston B that will move without friction, and let the piston weigh 2,116.2 lbs. Now if a perfect vacuum is maintained in the space A and if C contains 1 lb. of air=12,387 cubic ft. at a temperature of 32 degrees Fahr., the air will be under a pressure of about 14.7 lbs. per sq. in. and will maintain the piston at a height of 12.387 ft. If this air is now heated to 33 degrees Fahr., thus raising its temperature 1 degree Fahr., its volume will be increased, but the pressure will be exactly as it was before, because the piston has raised to make room for the increased volume of the air. According to experts, the amount of heat necessary to raise the temperature of the air 1 degree Fahr. under the above conditions would be 0.2379 B.T.U., then the specific heat of air with constant pressure is 0.2379.

Absolute zero is 458.4 degrees Fahr. and an absolute temperature is the absolute zero temperature plus the ordinary thermometer reading. The absolute temperature of a gas at 32 degrees Fahr. is 490.4 (458.4+32) and if the temperature were 0 degrees Fahr. the absolute temperature would be 458.4, while if the temperature were 32 degrees the absolute temperature would be 426.4 (=458 —32 degrees.) With the aid of this it will now be easy to understand how the volume of gases at different temperatures is computed by the Formula.

$$v = V \times \frac{458.4+t}{458+T}$$

in which V=volume of the gas at the new temperature T, v=volume of gas at the new temperature t.

We will now take another illustration; let Fig. 2 be a cylinder closed at both ends and having a cross sectional area of one sq. in., a depth of about 18 inches and a piston B capable of moving without friction. It must now be supposed that the space C contains 1 cubic foot of air at a temperature of 32 degrees Fahr. and that the piston is weighted so as to exert a pressure equal to atmospheric pressure on the sq. inch while a perfect vacuum is maintained in A. Regnault's experiments have proved that if the contents of C are now heated to 212 degrees Fahr. or through 180 degrees Fahr., the piston and its load will be raised 0.367 foot or to D and the cubic foot of air will be increased in volume to 1.367 feet.

If we start again with the temperature at 32 degrees Fahr. and the piston at E and extract instead of add 180 degrees Fahr. of heat or cool down the contents of C to 148 degrees Fahr., the piston will descend the same distance that it rose when the air was heated, namely, to 0.367 foot or to F. The extraction of another 180 degrees Fahr. by cooling down the contents of C would bring us down to G and to cause the piston to descend to H and thus contract the air in C to, theoretically speaking, nothing, would necessitate the air be cooled down would necessitate the air being cooled down

$$\frac{180}{.367}=490.4$$

degrees Fahr. below 32 degrees Fahr. or to 458.4 degrees Fahr. below zero. Absolute zero is 458.4 degrees Fahr. and an absolute temperature is the absolute zero temperature plus the ordinary thermometer reading. Air then is a gas subject to rapid expansion under the rise of temperature, and as we are dealing with volumes at atmospheric pressure, the lower the initial temperature is the more volumes we get and the lower the discharge temperature is. Below is a few readings which were obtained from a compression without using the cooler and shows the extent of heating for dry air when compression is performed.

Temperature of air before compression,		60 deg.	90 deg.
Temperature of air com.	15 lbs.	177 deg.	212 deg.
	45 "	317 "	362 "
	75 "	416 "	465 "
	90 "	455 "	507 "
	120 "	524 "	580 "

It is difficult to imagine under what conditions Mr. Duncombe obtained the results he claims to have with the different initial temperatures. But there is often a great mistake made in the purchase of an air compressor that will give entire satisfaction at sea level. It will not work as satisfactory in a vicinity of high altitude, for the atmospheric pressure falls from 14.7 lbs. at sea level to about 10 lbs. at 10,000 ft. above the sea level. Since the density of the air decreases with its pressure it is obvious that at such an altitude the total weight of air handled by a given displacement is considerably less than at sea level, and that to fill any volume, a rock drill, for instance, with air compressed to 90 lbs., a greater free air displacement will be necessary than would be required at sea level. And the higher the altitude the greater the heat of compression will be irregardless of the initial temperature.

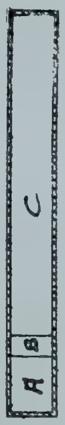


Fig. 1.

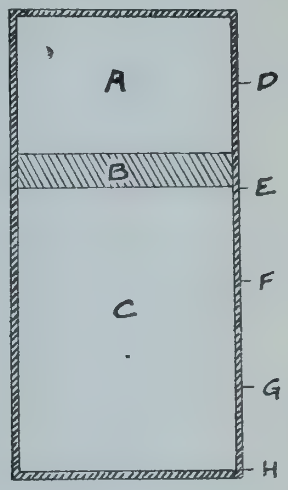


Fig. 2.—Air Compression.

THE POWER HOUSE

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THE STUDY HABIT.

Now that the warm summer evenings, with their numerous diverting influences are past, and the longer winter nights, which must perforce be largely spent indoors, are here, the mind of every truly ambitious person naturally turns towards influences that have an improving effect on the person.

Every person desires to better his position—be it from monetary or other considerations; this is universally true to a more or less extent, and nowhere will this be found more forcibly than among stationary engineers, a class of men who have a certain amount of time at their disposal while on duty, for observation and study.

The study habit has been defined by good authorities as "the cumulative result of practice in the acquisition of knowledge gained from the printed page," but we disagree to the extent that the study habit is not limited in this manner but also applies to information gained by observation, conversation and other sources, that is the gaining of knowledge by the study of whatever comes under the ken of the interested party.

Authorities have disagreed on what causes the study habit, but it is now generally conceded that, like other habits, good or bad, it must be acquired. Examples are on record, however, apparently disproving this statement—cases where people have taken to study naturally—but this only goes to bear out the statement that the exception proves the rule.

The secret of readily acquiring this valuable habit, a habit which is extremely beneficial in all walks of life, is to become deeply interested in the particular branch of study in which you desire to improve; make the subject so much a part of yourself, that you feel as though you must know all the knowledge there is to be had on the subject. When one comes to this stage, it may well be said that the study habit has been acquired. Interest, the more intense the better, is thus the keynote underlying the acquisition of this habit.

Considering the study habit, with regard to printed matter, you will read and re-read the article in which you are interested, until you feel that you could thoroughly explain the thought embodied, to a third party—that is, that the thoughts have become virtually your own. Similarly, in conversation, be on the alert for ideas. Study whatever remarks you hear on an interested subject, even though the party giving voice to these thoughts may not be an authority. Much can be learned from all sources, and many surprises will await the party of an analytical turn of mind, if the study habit has become a part of himself, so be ever on the alert to acquire knowledge from all sources. Use all your spare time to good advantage, remembering the old adage that "tomorrow never comes."

◆

AN IMPORTANT QUESTION.

The address of C. W. Leonard, C.E., before the Alumni Association of the Faculty of Applied Science, University of Toronto, recently, brought out a very important question in our Canadian life, namely—Why is it engineers from the United States are largely given preference for important positions in Canadian plants, even when good Canadian engineers are competing?

There must be some underlying reason, though from the matter of technical training, this does not seem to hold good, as exemplified by the speaker. As he pointed out, 80 per cent. of the copper plants of the United States are under the direction of Canadians, and plants where Canadians were not at the head, with few exceptions, have them second in command. As the United States supplies 60 per cent. of the world's copper requirements, it means that 48 per cent. of the world's output in the United States alone, is under the management of Canadians. Added to this that one of the largest smelters in Spain is likewise governed by a Canadian, it can be seen that they are held in high esteem outside their own land. Maybe this is another example of the fact that "a prophet is not without honor save in his own country." This example of the copper industry is just one of the many where Canadian technically trained men from our leading colleges and universities are being fully appreciated, having however, to leave their mother country to receive this recognition.

Proceeding in his remarks, Mr. Leonard showed that very few copper plants in the United States were under the management of native-born citizens. Then, why is it that here in Canada we don't recognize the value of our own men? The foregoing shows that it is not because we have not good men, but the reverse. Something is radically wrong in our system.

One reason pointed out for the failure of many, is the lack of power to command. The speaker, a graduate of the Royal Military College, believed that the obedience enforced there, taught a man to be a good master when his turn to command came forth. However, this last preamble applies equally well to to technical graduates from the United States, though the proportion of military engineering colleges is greater in that country. That may to a certain degree be the cause—their ability to assume command when occasion arises. However, from whatever cause, it nevertheless remains the case that engineers from the United States are given preference. This applies equally to engineers in all lines from the stationary to the consulting, and is a matter that should receive the deepest thought from employers in general. Have the same confidence in Canadian education that citizens of the United States have, and the matter is practically solved, for it is their unbounded confidence in Canadians and their abilities that has placed the Canadian engineers practising in the United States, in the enviable position which they hold.

◆

FOR THE GOOD OF THE ORDER.

With October comes the season when engineers meet for mutual instruction. For several winters we have attended engineering meetings, and several points in connection with them have occurred to us, which will, we hope, be found of benefit to those in charge of the preparation of programs.

When the question is asked: "Has anyone anything for the good of the order?" there should be a prompt response every meeting. Either a paper should be arranged for, to be presented by an authority outside the membership, or by a member of the association. In this way a subject is introduced in a very intelligent manner, questions may be asked, and the paper discussed, thus bringing to light many useful points that otherwise would have been passed over.

An opportunity should also be afforded for engineers to present their difficulties for discussion and thus aid in their self-improvement. In this way engineers become better engineers and better fitted for the positions they now occupy, and for still better positions when an opening of advancement is afforded.

The program committee will find that by arranging a definite "for the good of the order" program, that the meetings will become popular, engineers will attend in greater numbers, and the association will be the success it is intended to be.

◆

LUBRICATION ECONOMIES.

In a certain plant where an excellent oiling system was employed and where oil was used economically, a saving of 42 per cent. of the oil bill was made possible without sacrificing the efficiency. This was done by carefully selecting the lubricating oils and greases and by saving the small wastes.

There are two rules, which, if followed, will ensure economy in purchasing lubricants. 1. It should be determined exactly the quantity of oils and greases required and the physical properties of each. 2. These properties should be mentioned in specifications and tenders called for a year's supply.

Another saving may be effected by the introduction of an oil and waste saving machine. These are usually very simple in operation, and they save as much as 90 per cent. of the oil in the waste. As the waste in an engine room is used for cleaning the engine, mopping up oil, etc., it becomes saturated, and the amount of oil saved in this way is considerable.

Where oil is received in barrels, it often happens that one, or perhaps more of them, leaks. This, then, is another source of loss which may be practically eliminated by having an oil house and tanks into which the oil can be emptied as soon as received. Provision can also be made for gauging the oil and measuring any deficiency.

In the plant referred to in the first paragraph these rules were followed, and instead of spending $4425 for lubrication, the annual outlay was reduced to $2570, thus making a saving of about 42 per cent.

In making the chemical analysis of oils, it was found that cylinder oil of good quality could be purchased for 25 cents instead of 48 cents; machine oil at 14½ cents instead of 33 cents per gallon, and grease at 5 cents per lb. instead of 9½ cents. Slow speed machinery oil was purchased at 9 cents per gallon.

An important lesson in this connection is that the purchase of lubricants should be made by one with an expert knowledge of oils and greases and a knowledge of the requirements of machinery. Most engineers buy oil because they believe it is a good lubricant. Perhaps it is, but a chemical analysis will, perhaps, show the engineer where a great saving may be effected.

◆

WORKMEN'S COMPENSATION

For a number of years the MacLean papers have carried on a campaign for the protection of machinery and thus the elimination of a large number of industrial accidents. We recognize that accidents will happen, and, unfortunately, they are often attended by loss of life or limbs. If an employer was generous he made a position for the maimed workmen or provided for the widow and family. Sometimes the workman or his family made use of the courts but as companies with large capital at their back could appeal decisions and carry cases beyond the means of workmen, the final decision inevitably resulted in favor of the company.

In view of the above, therefore, it is gratifying to note that the Canadian Manufacturers' Association is taking cognizance of the workmen's claim for consideration and are trying to find a remedy for the conditions that now surround workmen. The Association suggests that

> "If the matter could be compromised by relieving from all further claims for compensation those employers who insure their pay roll up to the extent of a year and a half's wages, it would seem as though a solution of the difficulty could be reached that would be satisfactory to both sides, for in that event the cost of insurance could be accurately ascertained by the employer beforehand, and provision made for the same, while the employee in the event of an accident would receive the compensation to which he was entitled without having to have recourse to legal process. This arrangement, of course, presupposes that the employee would insure himself for an amout equal to that carried for him by the employer, so that in the event of fatality his family would receive the equivalent of three years' wages, which is generally conceded to be about right."

No doubt if an arrangement can be arrived at, it will help to remove any hard feelings existing between capital and labor on this account. A voluntary system of compensation might work satisfactorily in certain cases but in others, it would require the strong arm of the law to enforce workmen's rights. The question is one that could be dealt with by either the Provincial Governments or the Labor Department of the Dominion Government, to advantage.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must Have New and Interesting Features — No Write-Ups Can be Used.

FRICTIONAL RESISTANCE.

Not until about 1800 was any special attention given to the subject of frictional resistance, and as usual in those days, the Frenchmen took the initiative. Coulombo was among the first who made extended research regarding the laws of friction and determined the co-efficients of friction, which were published in 1821.

Some years later General Morin entered more deeply into the investigation of this subject under the direction of the French Government, the results of which were recorded in the Memoirs de L'Institute in 1833. His writings are accepted as standards and engineers are indebted to him for the first enunciation of the laws governing friction.

When it is considered that the apparatus by means of which Morin's laws were obtained consisted essentially of a traineau or sled, operated upon a rectilinear track, it is all the more remarkable that he should have obtained such standard results. Rotative devices are now used altogether, which give very much more accurate determinations, and modern scientists have spent much time in experimenting with various substances and alloys without arriving at any definite conclusions as to the frictional value of such alloys or the causes which occasion the variations shown in tests; indeed, there is a considerable divergence of opinion among scientists to account for these variations.

It is generally conceded, however, that metals have frictional individualities, and that certain compositions determine the frictional characteristics of alloys, and also that in certain alloys used for bearings, certain metals contained therein of low atomic value add to the frictional resistance. As for instance, antimonial lead, with its small proportions of arsenic, copper, iron, sulphur, etc., will not give as good results as a composition of pure lead and antimony regulus. All industrial alloys have been developed empirically, and the practical mechanic has evolved from his own observations and experience a knowledge of these facts, which have since been scientifically confirmed, and he knows that it is useless to look for the best results from metal made from such byproducts as antimonial lead, or which are gathered from the scrap pile, and he generally seeks for the best standard metals of known high uniform grade, although the cheaper products may show tentatively the same analysis.

The laws of friction, as announced by General Morin, were as follows:

1. The friction between two bodies is directly proportional to the pressure, i.e., the coefficient is constant for all pressures.

2. The coefficient and amount of friction, pressure being the same, are independent of the areas in contract.

3. The coefficient of friction is independent of velocity, although static friction (friction of rest) is greater than friction of motion.

Among modern investigators of these laws, Prof. John Goodman obtained the following results on the testing machines of Thurston, Tower and Stroudley:

1. The coefficient of friction for moderate pressures and speeds varies approximately inversely as the normal pressure.

2. The frictional resistance varies as the area in contact, the normal pressure remaining constant.

3. At very low journal speeds the coefficient of friction is abnormally high; but as the speed of sliding increases from about 10 to 100 ft. a min., the friction diminishes, and again rises when that speed is exceeded, varying approximately as the square root of the speed.

Prof. Thurston, a modern American scientist, defines friction as "that force always acting as a resistance which is experienced when it is attempted to move one body upon another which is pressed into close contact with it."

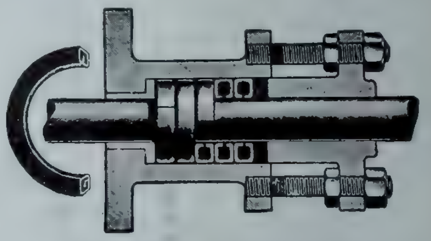
Friction is generally supposed to be due to the interlocking of the asperities of the two surfaces and abrasion by tearing them off. General Morin in his experiments developed the fact that metals of like structure bearing one upon the other, as iron upon iron, and steel upon steel, produce greater friction than will metals of different structure, as iron on brass. Science has not yet produced any improvements upon the industrial alloys; nor evolved any laws which would guide or assist the ordinary layman in his attempts to improve on present products.

Every investigator of this subject recognizes the work done by Prof. Goodman and constantly refers to him as the highest authority; and among the industrial alloys he has unquestionably placed his seal of approval upon magnolia metal, and calls special attention to the value of magnolia in reducing wear and frictional resistance by filling in the interstices of the journal, thereby preventing the interlocking of these asperities and abrasion of metal, and increasing the contact surface of the journal and bearing.

HUHN METALLIC PACKING.

Huhn metallic packing was placed on the British market about a year ago by Snowdon, Sons & Co., selling agents for the British Huhn Metallic Packing Co. This packing is now being placed on the Canadian market by Bain & Mitchell, Y.M.C.A. Building, Montreal.

The Huhn metallic packing has been designed for steam, water, air, acids, ammonia, brine, oil, tar, varnish, carbon dioxide, etc. It consists of square-sectioned, hollow, white metal rings. It is supplied in half-circles to fit any rod from ¼ inch diameter upwards. These rings are filled with lubricant, and the ends sealed up, so that the lubricant cannot come out except through the small holes which are drilled for the purpose in the working surface.


Huhn Patent Metallic Packing.

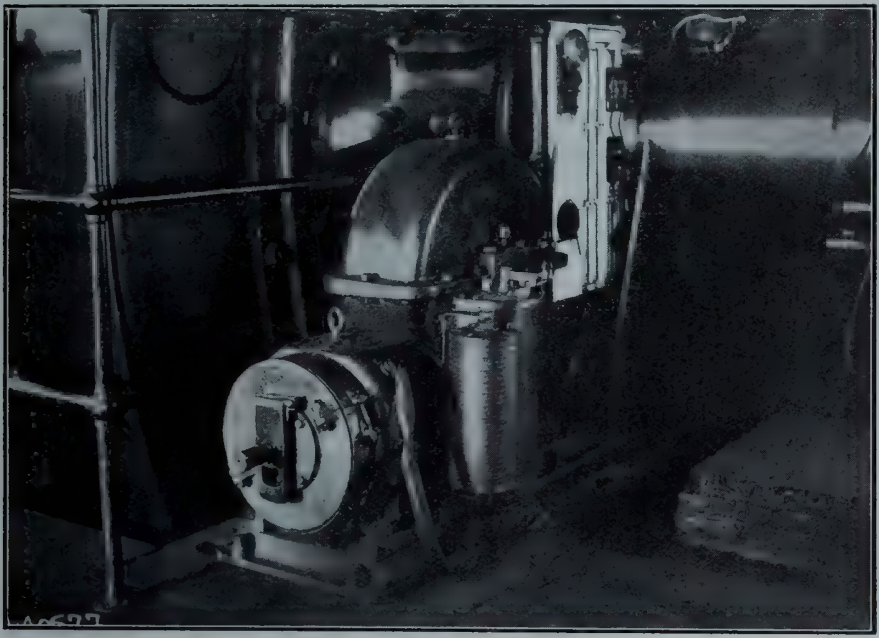
The Huhn packing for use on steam engines is filled with a graphite compound. The white metal rings will stand a temperature of 650 degs. F. For higher superheat soft copper is used, being made in exactly the same way.

The packing for water has the white metal rings filled with graphite compound, the only difference from the steam packing being that the top and bottom walls are provided with grooves extending from the inner circumference, and into which are fitted graphite rings or washers.

Packing for refrigerating machinery is of the usual square type without any grooves, but instead of rings in halves, they are in one complete circle. They have a cotton wad soaked in glycerine for horizontal machines and they are filled with graphite compound for vertical machines. A leather washer is laid between the two rings. Bain & Mitchell have some interesting circular matter on Huhn packing which they will mail on request.

BARRING OVER LARGE ENGINES.

The operation of barring over an engine, when it becomes necessary to change without steam, the position of the piston, for the purpose of making repairs, setting the valves or any other such purpose, is often a very hard task. In the case of large engines acceleration of all the parts that move, and sometimes of several driven machines as well, requires the combined efforts of several men, applied with a large leverage. The time of these men can be saved by a motor-driven appliance, such as the American Ship Windlass Co., Providence, R.I., designed to do away with the difficulty attending the turning over of a large engine at the works of the Stanley Co., Bridgewater, Mass.



Convenient Appliances for Barring Over Large Engines.

The illustration shows the barring machine geared to the fly-wheel of a 32 and 36-inch by 60-inch engine, nominally rated at 2000 horsepower, and running at 75 R.P.M. The engine drives seven pairs of rolls for sheet steel—four pairs of 14-inch and three pairs of 10-inch. The motor drives the spur gear shown in the cut, through the spur-gear reduction and the worm gear which are enclosed in the housing. The pinion shown engages an internal rack on the inner rim of the 20-ft., 75-ton flywheel. When the machine is not in use, the housing and pinion are drawn out of contact with the rack by means of a hand lever. The entire machine is mounted on one bedplate.

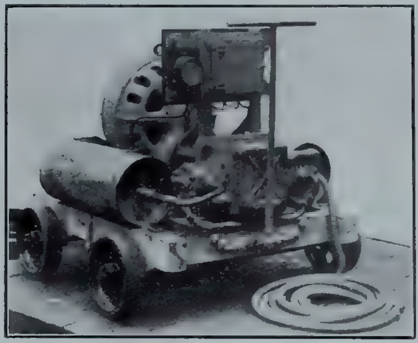
The 11-H.P. Westinghouse type K motor runs at 700 R.P.M. on a 220-volt D.C. circuit. It turns the flywheel through one revolution in about a minute. It is especially adapted for this and similar classes of service where a heavy starting torque and a considerable variation of speed are required. The motor is controlled by a Westinghouse type R-53 reversing controller, having five forward and five reverse notches that permit the speed to be adjusted over a considerable range.

An alarm bell is so connected with the barring appliance that it rings during the entire time that the pinion is in contact with the rack on the rim of the flywheel. By reminding the operator to throw the pinion and rack out of mesh before starting the engine forward, this warning bell serves to prevent damage to the motor.

PORTABLE AIR COMPRESSOR SET.

The operation of small portable equipments by electric motor has so much to recommend it in the way of convenience and economy that very extended use is now made of the method. The accompanying illustration shows a small portable air compressor equipment recently supplied, through C. J. Wharton, Consulting Engineer, London, to the Rio de Janeiro Flour Mills Granaries Co., Ltd., by the British Westinghouse Electric & manufacturing Co., Ltd., Manchester, which firm, a short time before, carried out the complete electrical equipment of these mills.

This equipment is used for blowing out the 600 h.p. motors, and for cleaning the the other machinery. It consists of a standard Westinghouse air brake compressor, driven through single reduction gearing by a 3 h.p. three phase Westinghouse squirrel cage motor complete with control panel mounted on a strongly built wooden trolley with rubber wheels, so that it can be easily moved from point to point. The current for operating it is taken from plug boxes on the walls by means of a flexible cable to a three pole, double throw, enclosed switch on the control panel, which is constructed of slate and mounted on strap iron framework, whence the supply is led to the motor through a unit type fuse box. The connections are so arranged that when the motor is thrown on the line at starting the fuses are cut out, and after the motor has attained a fair speed, the switch is thrown over to the other side, putting the fuses in circuit.



Portable Air Compressor Sets.

The importance of keeping electrical machinery free from dust cannot be over estimated, and compressed air direct from a compressor is the best form of dust remover, as it blows out all the crevices and cleans the windings thoroughly without affecting the insulation.

Among the new vessels launched from British shipyards and equipped with refrigerating plants, are mentioned the Highland Brae, built to the order of the Nelson Steam Navigation Co., which has all her cargo space insulated, and is equipped with duplicate refrigerating machinery, and the Aeneas built for the Ocean Steamship Co., Liverpool, intended for service between England and Australia, one of whose holds is insulated and equipped for carriage of frozen meat, dairy produce and fruit.

A writer in the Strand Magazine tells of the unique method of refrigeration used in the rural districts of Japan. At Takata, on the northwest coast, he found what he first imagined was a haystack, but which proved to be a mound of snow covered with straw. The mound, he found, was used to keep fish in cold storage during the summer season. These stacks, it was added, are to be seen in considerable numbers in different parts of the country.

Power Plant Developments.

British Columbia.

NEW WESTMINSTER.—The B. C. Packers' Association if arrangement can be made with C. P.R., will erect a large addition to the Columbia Cold Storage Plant. Mr. Geo. Cassady, manager.

VICTORIA.—D. B. Roberts, of London, Ont., who has been appointed inspector of electrical energy for the provincial government, was London's city electrical engineer. As his new duties will lie chiefly in Vancouver he will make his headquarters there and will work in conjunction with the inspectors of factories and tramways.

Manitoba.

WINNIPEG.—St. Boniface citizens would like to interest the Manitoba Government in a scheme of Government ownership of electrical power similar to the Ontario power project. A conference was held recently, at which delegates from most of the municipalities within a radius of one hundred miles of St. Boniface were present to discuss the question.

WINNIPEG.—Sealed tenders, addressed to the undersigned, and marked on the envelope "Tender for Machinery" and "Tender for Pumps and Motors," as the case may be, will be received at the office of the Commissioners of the Transcontinental Railway at Ottawa until the 18th day of October, 1910, for the machinery required for the equipment of a roundhouse at Lake Superior Junction, Ont., and for the centrifugal pumps and motors required for the sewage pumphouse at the Winnipeg shops, Winnipeg. Plans and specifications may be seen and full information obtained at the office of Mr. Gordon Grant, Chief Engineer, Ottawa, Ont., and of Mr. S. R. Poulin, District Engineer, St. Boniface, Man.

Ontario.

MORRISBURG.—The town has applied for 2,000 h.p. from the Hydro-Electric Commission at $16.33 per h.p.

PRESCOTT.—The town has applied for 1,000 h.p. from the Hydro-Electric Commission at $22.13 per h.p.

OTTAWA.—The firms which put in tenders for the Quebec bridge are :—The Maschinenfabrik Augobergnurnberg, Germany ; Pennsylvania Steel Company of Philadelphia ; the British Empire Bridge Company of Montreal ; the Darlington, Manchester & Cleveland, England, Bridge Companies combine in one tender ; The St. Lawrence Bridge Company, which is a combination of the Canadian Bridge Company, of Walkerville, and the Lachine Bridge Company, of Montreal.

LONDON.—The Scott Machine Co. have changed their name to the London Gas Power Co.

LONDON.—Sealed tenders to be addressed to the secretary of No. 3 committee of the City Council, London, will be received up to November 2nd, 1910, for the following : (1) Fire Engine, 800 to 1,000 gallons capacity ; (a) Automobile or motor fire engine, 700, 800, 900, 1,000 gallons capacity, imperial measure with regular equipments and instructions. F.O.B. London, Ont., Any other particulars may be obtained by writing either Alderman H. Ashplant, chairman of No. 3 committee, or John Aitken, chief fire department.

HAMILTON.—The Oliver Chilled Plow Works have taken out a permit for a power house to cost $30,000.

TORONTO.—The Hydro-Electric Power Commission is endeavoring to secure power from companies in the eastern portion of the province for a number of municipalities who have applied for it. The following municipalities have asked for estimates of the prices they will have to pay for electric energy :—Kingston, 2,500 horse-power; Deseronto, 300 horse-power ; Belleville, 3,200 horse-power ; Brockville, 500 to 1,000 horse-power; Oshawa, 500 horse-power ; Cobourg, 800 horse-power ; Bowmanville, 600 horse-power ; Picton, 500 horse-power ; Durham, 2,000 horse-power.

Quebec.

MONTREAL.—The Hydro-Electric Power Commission of Ontario have awarded to Allis-Chalmers-Bullock, Ltd., Montreal, the contract for the electrical equipment of the sub-station at Port Credit, including four transformers 1,250 K.V.A. 25 cycle, single phase, 63,500 to 13,200 volts for operation on their 110,000 volt high tension transmission lines.

WARREN, WEBSTER & CO. BEATEN IN "PATENT" CASE.

By the decision of the United States Circuit Court of Appeals, opinion by Judge Sanborn, announced on September 19, 1910, the decree of the United States Circuit Court for the Southern District of Iowa, is affirmed in the case of Warren Webster & Co. vs. C. A. Dunham Co.

Warren Webster & Co. was the plaintiff and C. A. Dunham Co., Marshalltown, Iowa, the defendant in a case commenced in November, 1906, in the United States Circuit Court at DesMoines, Iowa, for injunction and damages on account of alleged infringement of Hall Patent No. 454964. On final hearing before Judge Smith McPherson, of the United States Circuit Court, the Plaintiff's bill of complaint was dismissed and a decree entered in favor of C. A. Dunham Co.

An appeal from this finding and decree was taken by Warren Webster & Co., and the case on appeal was submitted before the Circuit Court of Appeals at St. Paul, Minn., on May 17, 1910. The decision and opinion affirming the decree of the Circuit Court puts an end to almost four years of litigation. The C. A. Dunham Co. tried the case on the legal merits of the patent. —(A.)

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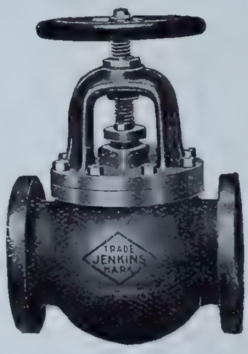

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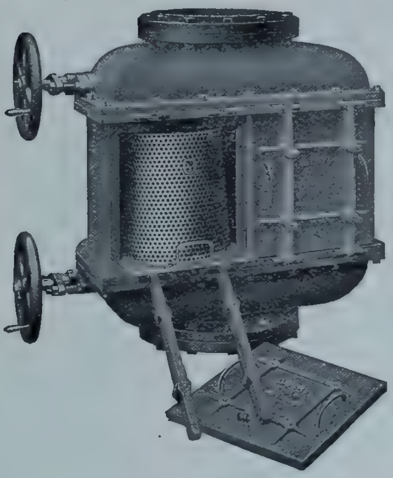
The Liberty "Turbine" Tube Cleaner

The Liberty Twin Strainer



The Liberty Greenaway Horizontal Oil Separator

The cuts shown on this page illustrate a few of the "Liberty" Appliances that are now in "active service" in hundreds of the most modern power plants throughout Canada and the United States. There's nothing experimental about "Liberty" Appliances, they are the finished products of years of development.

The "Liberty" Catalogue is very interesting Write for it."

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The advertiser would like to know where you saw his advertisement—tell him.

Annual Feed Water Number of the Power House, November, 1910

¶ The articles in our November issue will deal almost exclusively with the Treatment of Feed Water and the latest appliances and methods of handling same.

¶ Manufacturers of and dealers in these appliances should take advantage of this number and make the story regarding their appliances as complete as possible in liberal space.

¶ The number will be practically a text book on the subject treated, and will thus be kept for reference purposes by our readers.

¶ Make a strong appeal to engineers in charge of the best plants all over Canada at a time when they are thinking of the very appliances you have to sell.

¶ Remember that the engineer IS PAYING to receive "The Power House"—to receive the information it is your privilege to give him about your product.

SOME OF THE CONTENTS

Corrosion and Incrustations, by John Bradley
Boiler Feed Pumps, by J. O. B. Latour
Some Interesting Facts About Water, by W. A. Converse, Dearborn Drug & Chemical Works.
Steam Boiler Inspection, by James Noble.
Water Softening in Connection with Steam Raising, by Maurice A. Wood.
A Simple Water-Softening Plant of Large Capacity.
The Fuel Economizer: Its Relation to the Feed Water, by F. H. Moody.
Mechanical and Chemical Methods of Purifying Water, by G C. Keith.
Regulating the Supply of Feed Water Automatically.
PRACTICAL LETTER DEPARTMENT—A number of letters on Boiler Feed Water have been received and an excellent department of practical letters on this subject will appear in the November issue.

The Power House will reach for you the engineer in any of the plants mentioned below:

- Textile Mills
- Pulp and Paper Mills
- Grist Mills
- Saw Mills
- Rolling Mills
- Steel Mills
- Planing Mills
- Machine Shops
- Car Shops
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- Piano Factories
- Factories of Every Description.
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- Cold Storage Warehouses
- Dairies
- Packing Houses
- Office Buildings
- Public Buildings
- Apartment Houses
- Hotels
- Steam Boats
- Laundries
- Dye Works
- Gas Works
- Chemical Plants
- Glass Works
- Oil Refineries
- Grain Elevators
- Mines
- Municipal Lighting and Power Plants
- Water-Works
- Hydro-Electric Plants
- Central Stations

Forms close November 4. Write now for rates and reserve space early.

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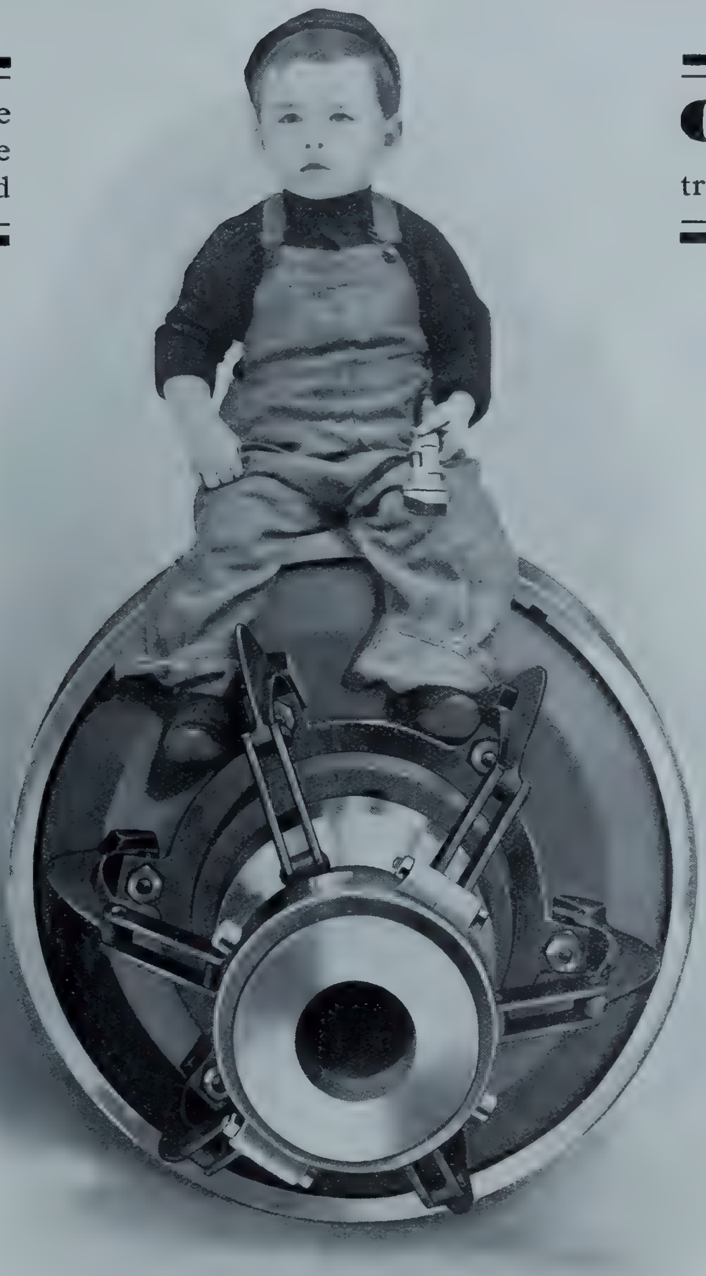

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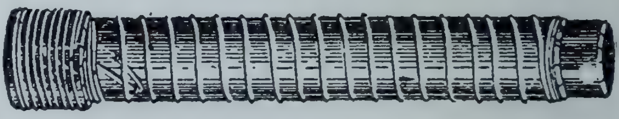

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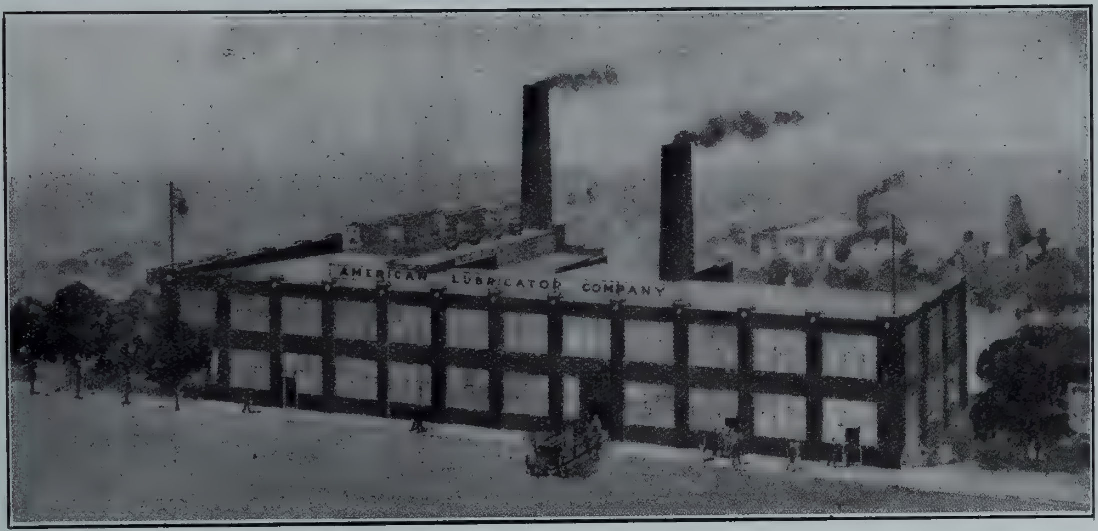

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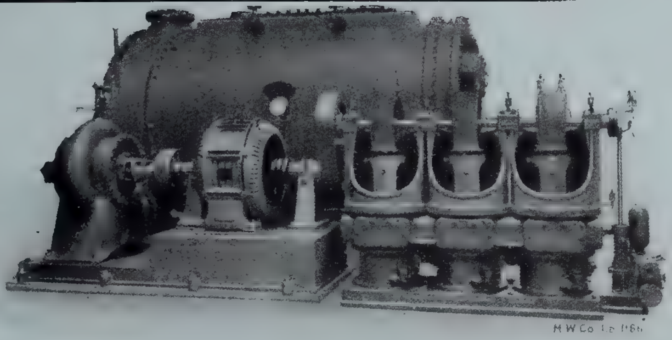

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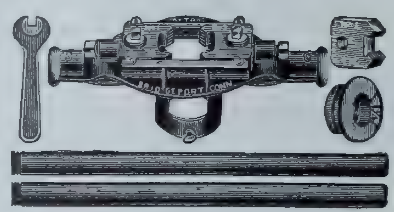

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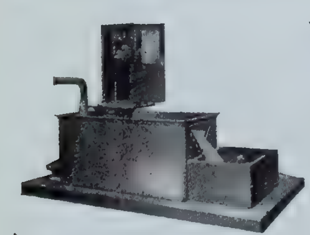

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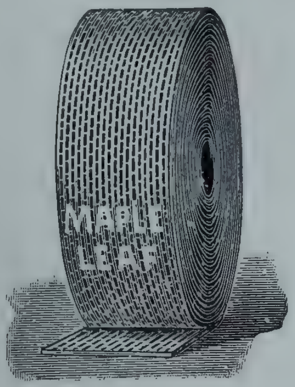

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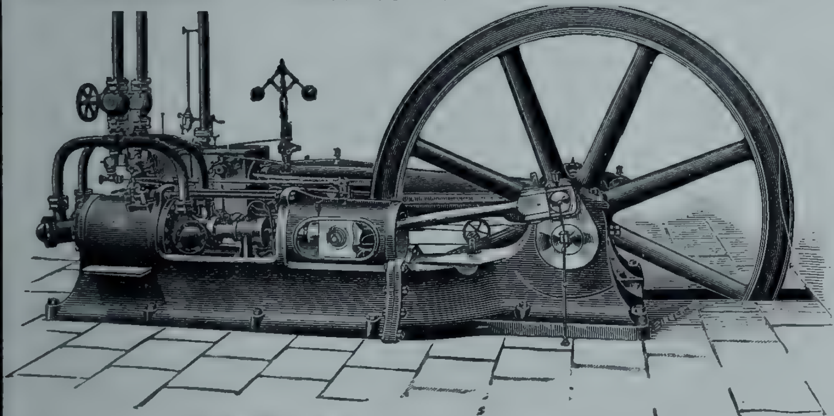
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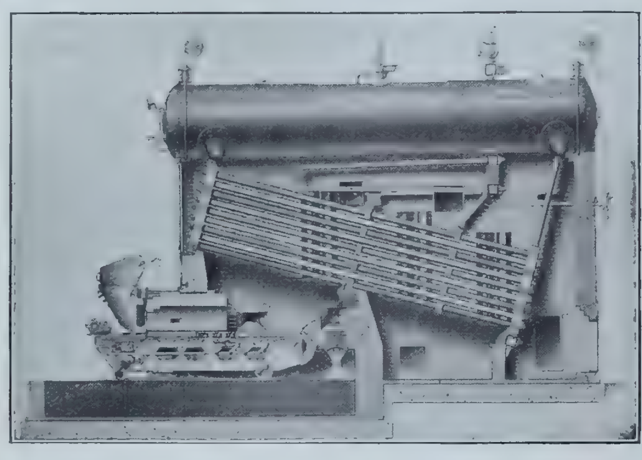

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Goldie & McCulloch Co., Galt.
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Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
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The Wm. Hamilton Co., Peterborough

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Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
E. Leonard & Sons, London, Ont
Jno. McDougall Caledonian Iron Works, Montreal
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Boilers, Locomotive

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The Wm Hamilton Co , Peterborough
E. Leonard & Sons, London, Ont

Boilers, Marine.

Babcock & Wilcox, Montreal
Goldie & McCulloch Co., Galt.
The Wm Hamilton Co., Peterborough.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
E. Leonard & Sons, London, Ont
Polson Iron Works, Toronto
Robb Engineering Co., Amherst, N.S.
Waterous Engine Works Co., Brantford.

Boilers, Vertical.

Goldie & McCulloch Co., Galt.
The Wm. Hamilton Co., Peterborough.
Jno. Inglis Co., Ltd., Toronto
Jenckes Machine Co., Sherbrooke, Que.
E. Leonard & Sons, London, Ont
Polson Iron Works, Toronto
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Boilers, Water Tube.

Babcock & Wilcox, Montreal
The John Inglis Co., Ltd., Toronto
E. Leonard & Sons, London, Ont
Polson Iron Works, Toronto
Jno. McDougall Caledonian Iron Works, Montreal
Robb Engineering Co., Amherst, N.S.

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American Lubricator Co., Detroit

Indicators, Electric—All Types.

Canadian Westinghouse Co., Hamilton
Geo. C. Royce, West Toronto

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Canadian Westinghouse Co., Hamilton

Lamps, Incandescent

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Darling Bros., Montreal
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Lunkenheimer Co., Cincinnati
Michigan Lubricator Co., Detroit
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American Lubricator Co., Detroit

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Lunkenheimer Co., Cincinnati, Ohio

Lubricators, Steam,

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Michigan Lubricator Co., Detroit
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Oilers, Multiple.

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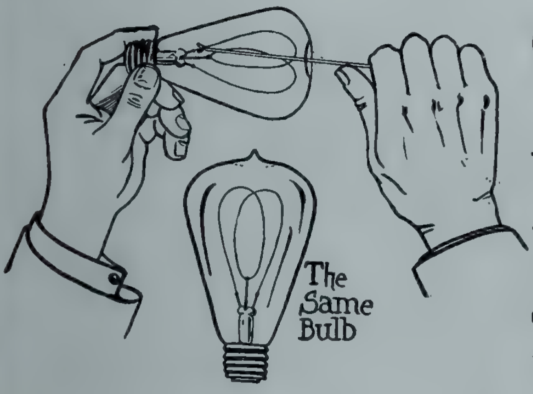

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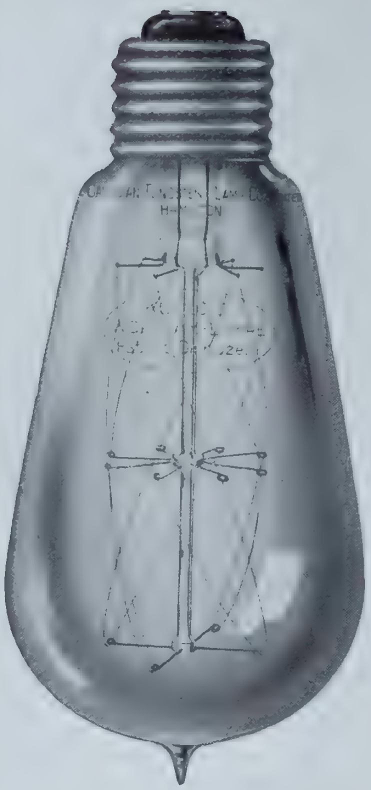

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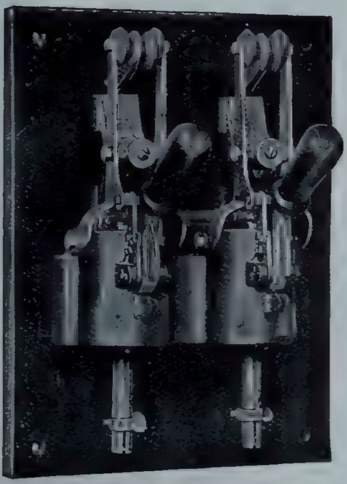

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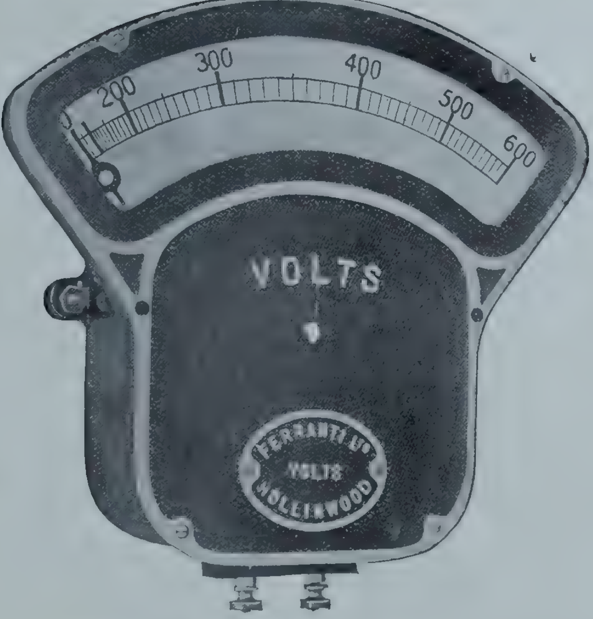

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Standard Engineering Co., Toronto.
Watson & McDaniel Co. Philadelphia

Pump Regulators.

H. L. Peiler & Co , Montreal
Watts Regulator Co., Montreal

Pump Strainers.

Canadian Steam Boiler Equipment Co., Toronto
Liberty Mfg. Co., Pittsburg, Pa.

Pumps, Air,

Canadian Fairbanks Co., Ltd., Montreal
The John Inglis Co., Ltd., Toronto
E. Leonard & Sons, London, Ont
Lunkenheimer Co., Cincinnati, Ohio

Pumps, Centifrugal

Jno. Inglis Co., Ltd., Toronto
E. Leonard & Sons, London, Ont
Jno. McDougall Caledonian Iron Works, Montreal

Pumps, Geared

Canadian Fairbanks Co., Ltd., Montreal
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Pumps, Oil.

Detroit Lubricator Co., Detroit
Lunkenheimer Co., Cincinnati, Ohio
Michigan Lubricator Co., Detroit
Richardson-Phenix Co., Milwaukee, Wis

Pumps, Steam

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The John Inglis Co., Ltd., Toronto
E. Leonard & Sons, London, Ont
Jno. McDougall Caledonian Iron Works Montreal

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Drummond, McCall & Co., Montreal

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Vilter Mfg. Co., Milwaukee, Wis.

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Canadian Westinghouse Co., Hamilton

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Positive Clutch & Pulley Works, Toronto
Waterous Engine Works Co., Brantford,
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The Wm. Hamilton Co., Peterborough

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Canadian Steam Boiler Equipment Co., Toronto

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Steam Pumps.

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Morehead Mfg. Co., Detroit, Mich.
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Reliance Gauge Column Co., Cleveland, Ohio
Strong, Carlisle & Hammond Co., Cleveland
Watson & McDaniel Co., Philadelphia

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Babcock & Wilcox, Montreal

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Chapman & Walker, Ltd., Toronto
Geo. C. Royce, West Toronto

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Vancouver School of Engineering, Vanconver, B.C.

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Positive Clutch & Pulley Works, Toronto
Waterous Engine Works Co., Brantford

Trucks, Factory.

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H. L. Peiler & Co., Montreal

Tubes, Boiler,

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The John Inglis Co., Ltd., Toronto

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Chas. Barber & Sons, Meaford, Ont.
The Wm. Hamilton Co., Peterborough
Jenckes Machine Co., Sherbrooke, Que.
The Madison Williams Mfg. Co., Lindsay, Ont.

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Drummond, McCall & Co., Montreal

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H. L. Peiler & Co., Montreal
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Jenkins Bros., Montreal
Kerr Engine Co., Walkerville, Ont.
Liberty Mfg. Co., Pittsburg, Pa.
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Michigan Lubricator Co., Detroit
Standard Engineering Co., Toronto.
Watson & McDaniel Co., Philadelphia

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Liberty Mfg Co., Pittsburg, Pa.
Lunkenheimer Co., Cincinnati, Ohio
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Watt Meters.

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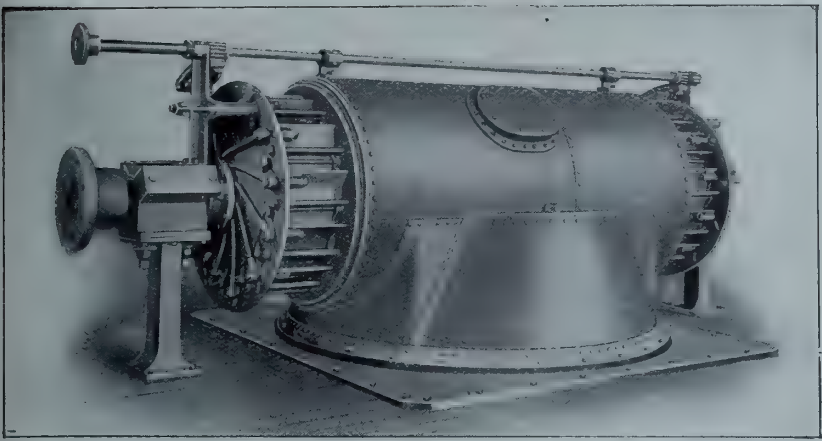

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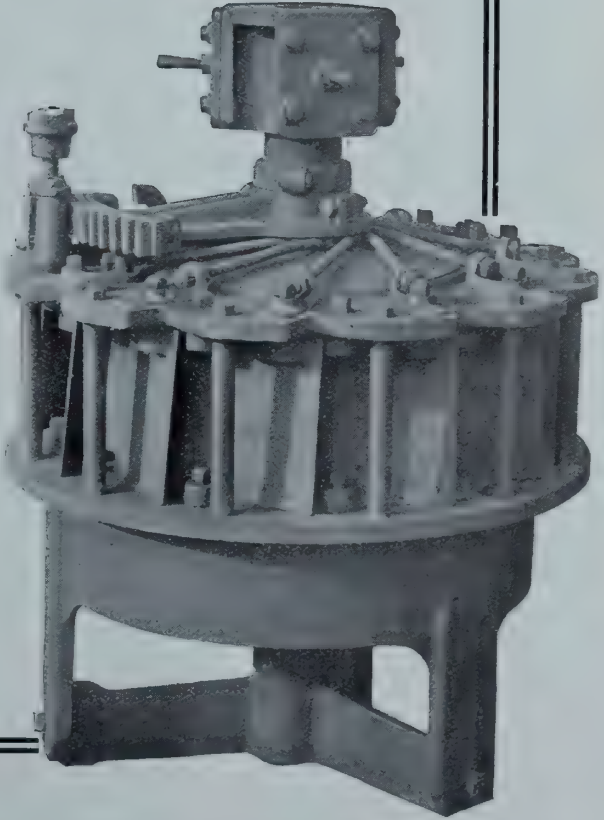

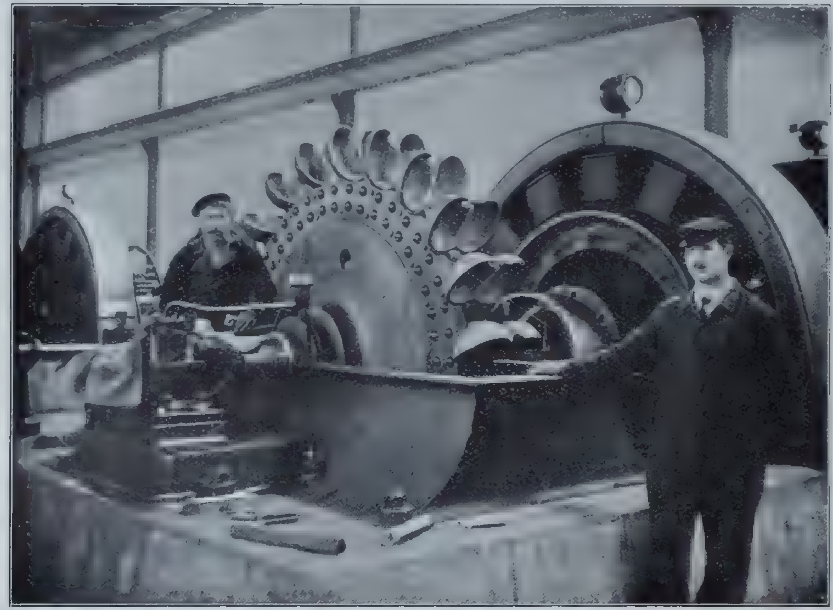

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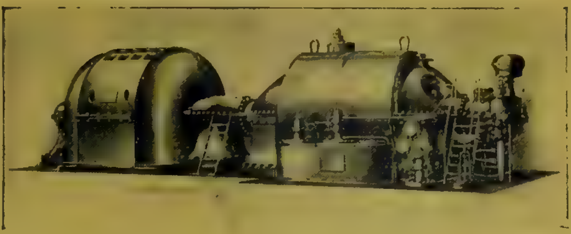
Westinghouse Steam Turbines

Years of service have no effect on the economy of Westinghouse Steam Turbines



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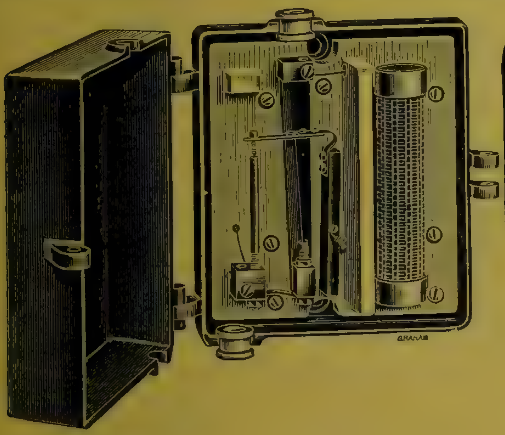

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For Electric Lighting Companies

The N.C.S. THERMAL LIMITER

(PATENT)

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THE WAY IT WORKS

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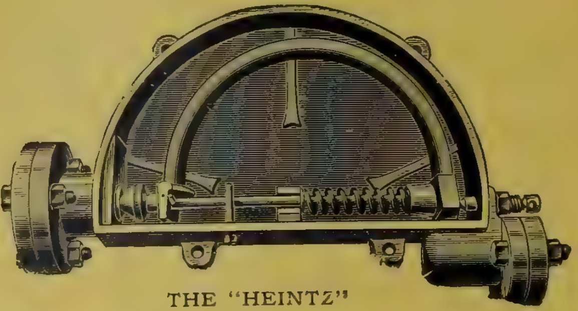
TRADE MARK J.M.T. REGISTERED A GUARANTEE OF QUALITY



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The Heintz Steam Saver or Steam Trap has probably the largest sale of any Steam Trap upon the Market. Its reliability is unquestioned. Its simplicity and efficiency are well-known. Very compact in construction, making it possible to install where other traps could not be used.

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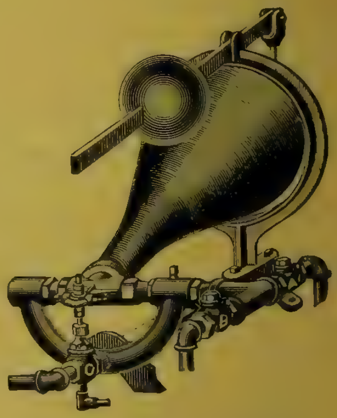

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Every plant operated by steam requires one or more steam traps. Some industries require a trap in connection with each individual machine in use, to automatically carry off the condensed steam that forms.

There are various traps upon the market, all giving more or less satisfaction, some operate successfully for a time, then require continued attention and repairs, which adds expense and annoyance. The success of an article is generally determined by the demand for same. If you want to be one of those satisfied trap users, install a "Heintz" Thermostatic Trap, a Nason, or an Anderson Bucket Trap.

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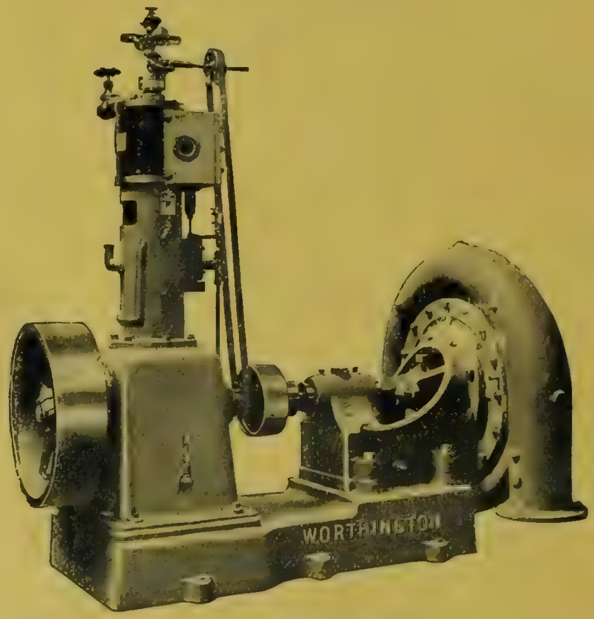

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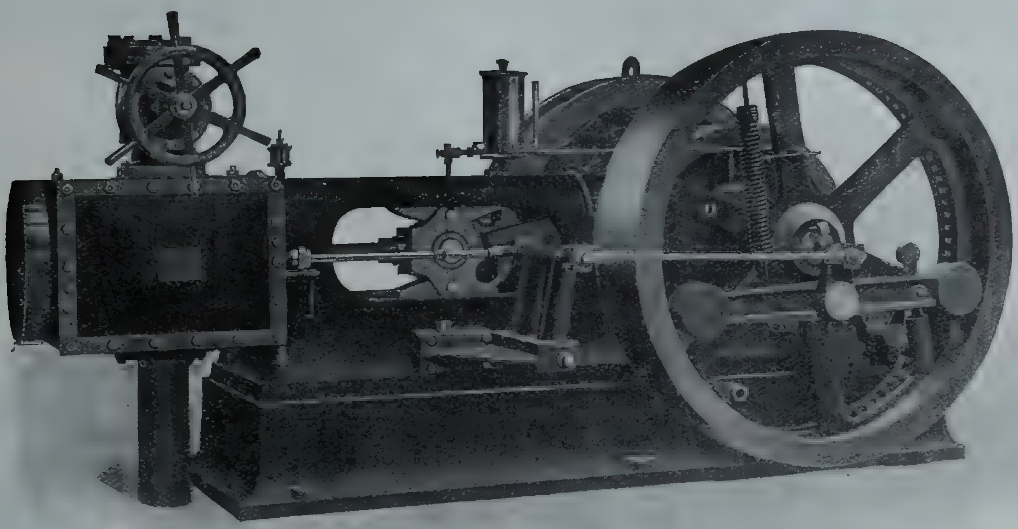

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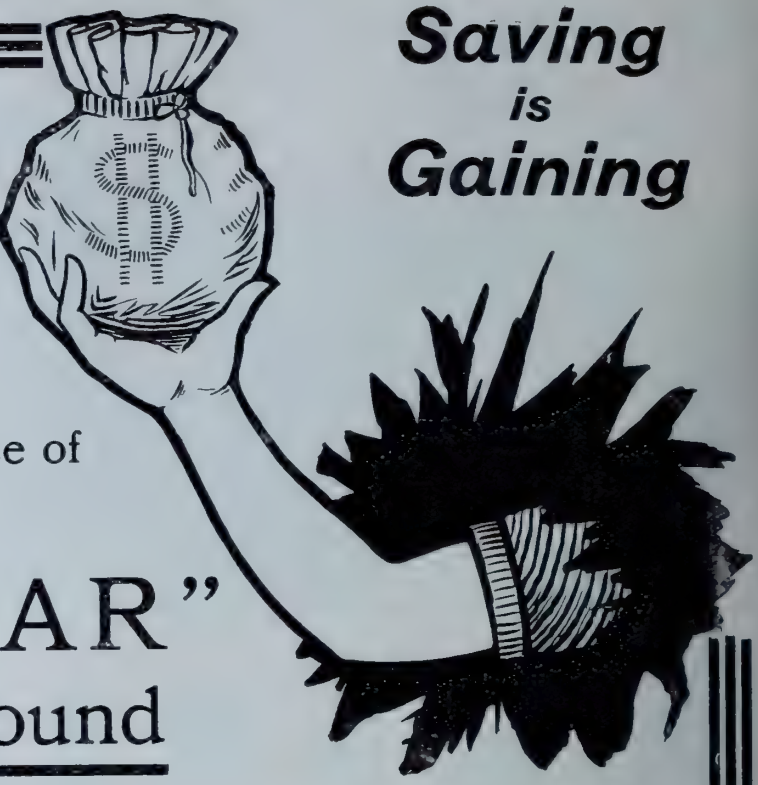

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SEND IT TO-DAY

DON'T FORGET THIS

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COMPRESSED SHEET PACKING

Absolutely the best sheet packing for High, Low, or Superheat Steam, oils, ammonia, alkalies, acids, sugar solutions, etc.

Manufactured under enormous pressure and does not require to be FOLLOWED UP.
WILL NOT SQUEEZE OR BLOW OUT. DOES NOT GET HARD.

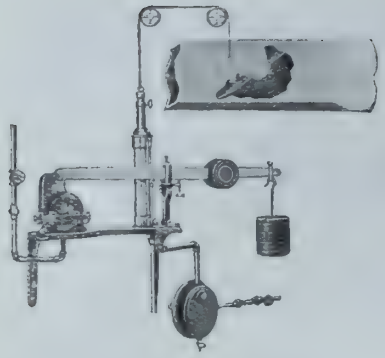
Try it on your most troublesome joint. No cure—No pay

MANUFACTURED BY

TURNER BROS., CANADA, Limited

Factory: 18 St. Peter St. Montreal Office: Coristine Bldg.

"EVERYTHING IN ASBESTOS"

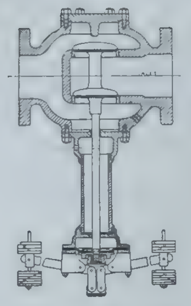


Lawrence Damper Regulator

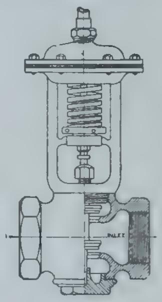
WATTS REGULATORS

are sold on trial and their service is

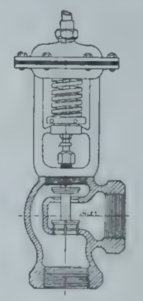
Guaranteed



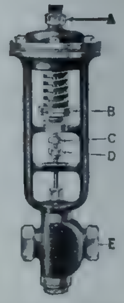
Lever Reducing Valve



Spring Reducing Valve



Pump Regulator



Fan Engine Regulator

Embodying, as they do, principles of correct design and accurate workmanship, these specialties are worth considering when in need of such. They will not fail at crucial moments, but continuously perform positive service. Get prices anyway, if only for sake of comparison.

Made by

Watts Regulator Co., Lawrence, Mass.

Sold in Canada by

Power Economies, Limited, 9 St. Nicholas Street **Montreal**

CYCLONE FANS

Embody Thirty Years' Experience in the

Design, Construction and Application

for all purposes, and therefore

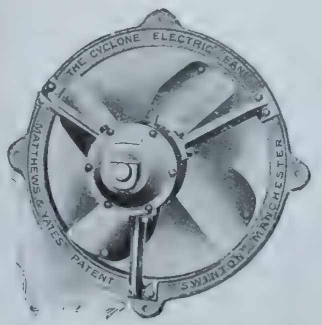
Cannot be Approached

for

Efficiency

and

All Round Satisfaction



* * *

MATTHEWS & YATES
Limited

Swinton, Manchester, Eng.

Agents for Eastern Canada: Bain & Mitchell, Y.M.C.A. Bldg., Montreal

Agents for Central Canada: Anglo-American Supply Co., Limited; 311 Enderton Buildings, Winnipeg

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We Want You to Know

That We Manufacture

- STEAM BOILERS OF ALL KINDS,
- STRUCTURAL IRON AND STEEL,
- HAND POWER CRANES,
- PENSTOCKS, RIVETTED PIPE,
- IRON and STEEL TANKS of all kinds and sizes, including water, oil or transformer tanks.
- STEEL FIRE ESCAPES
- STEEL LADDERS AND STAIRWAYS
- AIR RESERVOIRS.

We are experts in the Oxygen-Acetylene process of welding, which we use largely in Tank work.

We would like you ***to give us a chance*** to supply your requirements in any of these lines.

International Marine Signal Co.
Limited

Ottawa, Canada

TRADE MARK

A Great Authority's Opinion

Great Scientists, as well as the Mechanical world, have placed their Seal of approval upon Magnolia Metal, and we consider the following letter among our most valuable assets:

MASON COLLEGE, BIRMINGHAM, ENGLAND

Birmingham, England.

Messrs. The Magnolia Metal Company :
Gentlemen :

This is to certify that I have made a series of tests of your Magnolia Metal in a machine specially designed to reproduce as nearly as possible the practical working condition of machine bearings. I have also made a series of exactly similar tests in the same machine on the best quality of Babbitt and gun metal.

A detailed report of these tests was forwarded to you recently. The experiments were made on three diameters of journal, four different lengths, four different speeds, and five different pressures. In all between three and four hundred tests were made, in each of which the temperature of the bearings and friction were carefully measured. The numerical results are set forth in the detailed report in fourteen tables and a number of diagrams.

I am pleased to state that your metal is proved by these tests to be much superior to either Babbitt (genuine) or gun metal. It produces less friction, it keeps the bearing temperature lower, requires less lubrication and possesses greater durability. This characteristic of durability is a most important one. Within the wide limits of condition covered by my tests, it would be true to say that the longer the Magnolia Metal Bearing is used, and the more severe the duty imposed on it, the better becomes its conditions.

It is satisfactory to note that the elevation of bearing temperature above that of the surrounding air is, under all ordinary conditions, extremely low. With prolonged use the temperature shows no tendency to rise, and the surface becomes more and more smooth and glassy.

The general conclusion at which I have arrived from these experiments is that Magnolia Metal is a very excellent material for bearings; that its special good qualities appear more particularly when it is subjected to intense pressure, such as could not be borne by other metals without firing or melting, and that under very trying circumstances the Magnolia Metal may be trusted to remain cool; that is, at a temperature that does not interfere with good working.

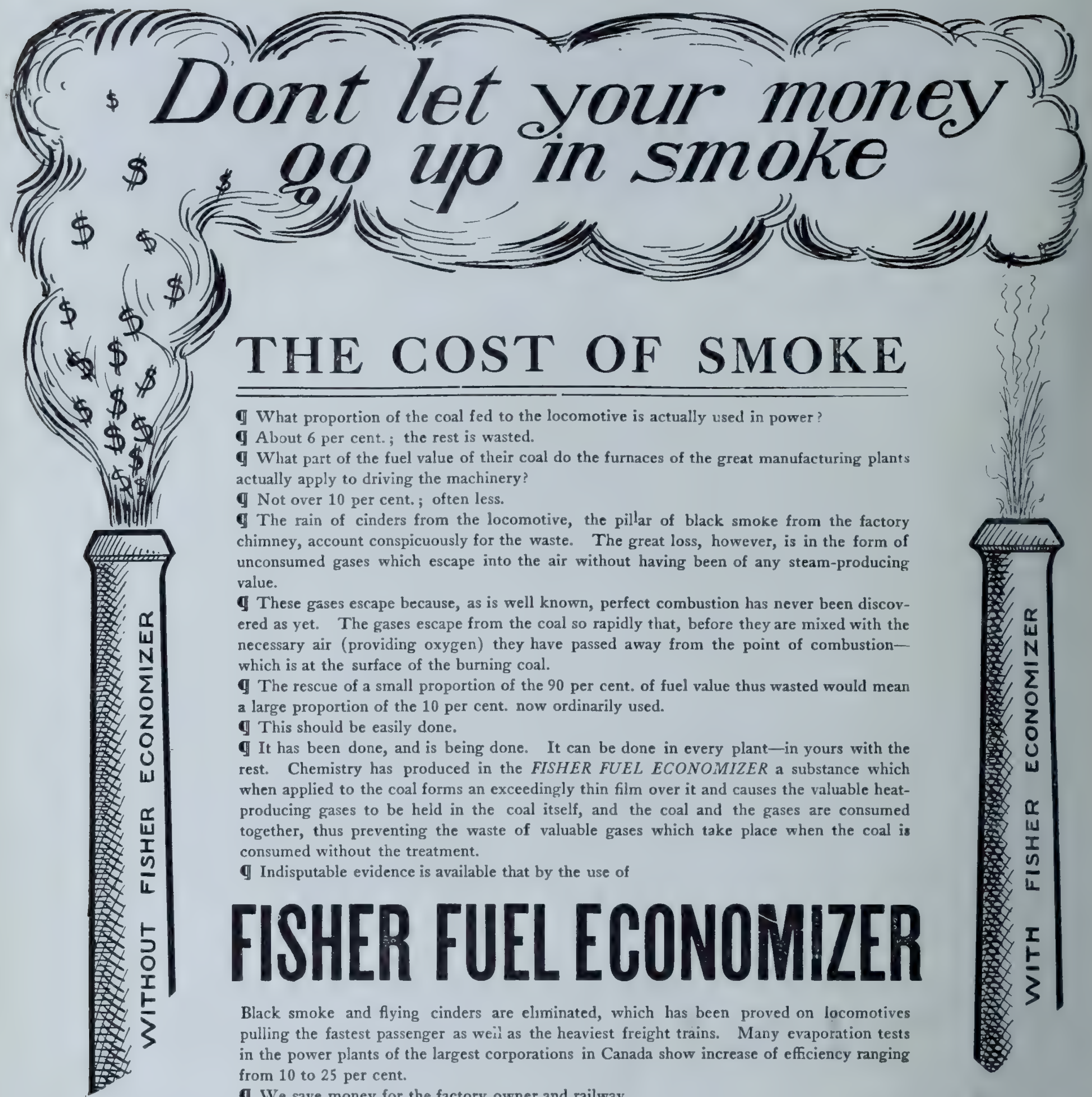
I am, Gentlemen,
Yours truly,
ROBERT H. SMITH.
Professor of Engineering, Am. I.C.E., M.I.M.E., etc.

Sold by leading dealers everywhere or by

Magnolia Metal Co., 225 St. Ambroise Street, Montreal

New York Chicago

SPECIAL OFFER PRACTICAL ENGINEER POCKET BOOK, containing 680 pages, treating on over 2,000 Engineering and Mechanical Subjects, brought up to date. We offer this valuable reference work at the very low price of 40 cents postage prepaid. Address Montreal Office



THE COST OF SMOKE

¶ What proportion of the coal fed to the locomotive is actually used in power?

¶ About 6 per cent.; the rest is wasted.

¶ What part of the fuel value of their coal do the furnaces of the great manufacturing plants actually apply to driving the machinery?

¶ Not over 10 per cent.; often less.

¶ The rain of cinders from the locomotive, the pillar of black smoke from the factory chimney, account conspicuously for the waste. The great loss, however, is in the form of unconsumed gases which escape into the air without having been of any steam-producing value.

¶ These gases escape because, as is well known, perfect combustion has never been discovered as yet. The gases escape from the coal so rapidly that, before they are mixed with the necessary air (providing oxygen) they have passed away from the point of combustion—which is at the surface of the burning coal.

¶ The rescue of a small proportion of the 90 per cent. of fuel value thus wasted would mean a large proportion of the 10 per cent. now ordinarily used.

¶ This should be easily done.

¶ It has been done, and is being done. It can be done in every plant—in yours with the rest. Chemistry has produced in the *FISHER FUEL ECONOMIZER* a substance which when applied to the coal forms an exceedingly thin film over it and causes the valuable heat-producing gases to be held in the coal itself, and the coal and the gases are consumed together, thus preventing the waste of valuable gases which take place when the coal is consumed without the treatment.

¶ Indisputable evidence is available that by the use of

FISHER FUEL ECONOMIZER

Black smoke and flying cinders are eliminated, which has been proved on locomotives pulling the fastest passenger as well as the heaviest freight trains. Many evaporation tests in the power plants of the largest corporations in Canada show increase of efficiency ranging from 10 to 25 per cent.

¶ We save money for the factory owner and railway.

¶ We save the fireman much hard and dirty work.

¶ We save the black smoke which pollutes the air.

¶ We reduce your ashes and clinkers half.

¶ We increase and maintain steam to a degree which is impossible without the economizer.

¶ We keep your boiler tubes and grate bars clean, reducing expense of upkeep.

Let Us Prove It to You. Write To-day for Information

Phone Main 2390

Fisher Fuel Economizer Limited

Head Office, 74 Bay St., Toronto, Ont.

MONTREAL	OTTAWA	WINNIPEG
Gerald Rowe, 187 McGill Street	569 O'Connor Street	310 McGreevy Block
Phone Main 811	*Phone 4494*	*Phone Main 2750*

The Automatic Smoke Preventer

saves coal by burning smoke

HERE'S THE WAY IT WORKS: Our way of preventing smoke is to force into the fire at the time the hydro and free carbons are being liberated from the fuel, sufficient oxygen to ignite these carbons, thus making them into valuable heat instead of allowing them to escape unconsumed in clouds of smoke.

A. McDonald, Esq.,
Automatic Smoke Prevention Co.,
342 Craig Street West, City.

Dear Sir:—Replying to your enquiry as to my opinion of the Smoke Preventors installed on our Babcock & Wilcox Boilers in this Building last Fall.

The Devices have given us entire satisfaction, and we have had no trouble with them whatever, and it is the best Smoke Preventing Device that I have seen. We would be pleased to show it to any one calling on us.

Yours truly, W. H. HOSKETT,
Bldg. Supt. Eastern Townships Bank Bldg.

January 22nd, 1908.

A. McDonald, Esq.,
Automatic Smoke Prevention Co., Montreal.

Dear Sir:—The Automatic Smoke Prevention Apparatus you installed in our Boiler-room four months ago has fulfilled all you guaranteed.

It is very satisfactory in operation, and we are highly pleased with the results.

We shall be pleased to show this installation to any one interested.

Yours truly,
LAURIE ENGINE AND MACHINE CO., LTD.
A. D. Ross, Superintendent.

Here is Strong Proof— Read These Letters

!!!

¶ You know these firms are far too big to give an undeserved testimonial.

The Automatic Smoke Prevention Co.,
342 Craig St. W., Montreal, Que.

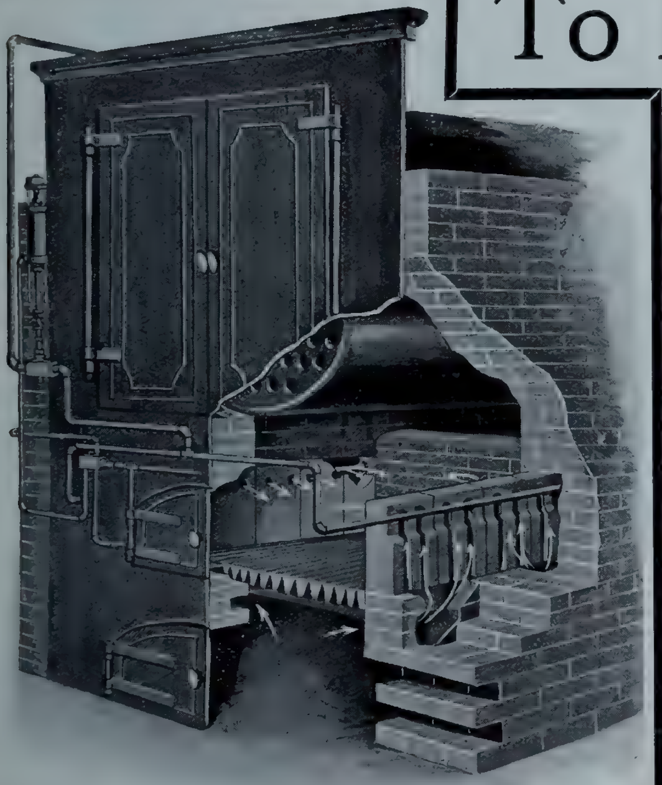
Gentlemen:—The Smoke Consuming Device which you installed for us in December last has now been in use about six months, and we are pleased to state it continues to give most satisfactory results. We have tested it upon different occasions by shutting off the apparatus and "firing up" in the usual way, with the result that dense volumes of smoke would continue to issue from stack for several minutes. Upon putting your device into service (after proper adjustment) and again "firing up," the smoke would disappear at stack in about 30 seconds.

We formerly had occasional complaints of the smoke nuisance we produced, but since the installation of your device this trouble has been overcome.

Although we have made no test to compare fuel consumption, yet our Engineer reports there is some saving due to the change.

Your device is the best apparatus we know of for the purpose, and we would be pleased to show it to anyone who may call upon us.

Yours very truly,
THE JAMES MORRISON BRASS MFG. CO., LTD.,
C. E. Morrison,
Secretary-Treasurer.
C.E.M.



To Engineers —

It is fairly up to you to investigate our claims because we really can help you to prevent smoke and save coal.

And that means we can help you to operate your department more economically and efficiently.

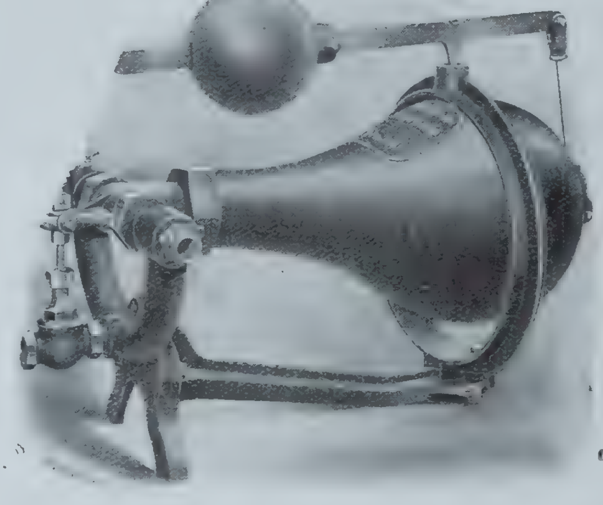
JUST PUT DOWN YOUR POWER HOUSE FOR A MOMENT AND WRITE US A POST CARD ASKING FOR CATALOGUE

The Automatic Smoke Prevention Company

342 Craig Street West
Montreal

We are Specialists in Reli

The Trap That Beats Them All



If thousands of actual installations, every one of which is giving perfect satisfaction, are any indication of pre-eminence, then there's nothing to it but the Bundy.

The "BUNDY" Steam Trap

is a wonderful saver of fuel and money. Experience shows that the Bundy usually more than repays its cost in less than a year by the saving in fuel that it effects.

The Bundy is the simplest trap made. It operates purely by gravity.

Let us help you out of all your condensation and boiler feeding troubles. We know how.

The "Reilly" Multicoil

is the common sense feed water heater and does not scale

It furnishes one more striking proof that the simplest thing is the best. Just read this brief outline of its construction:

> Water from the boiler feed pump is led to a header at the top or bottom of the heater from which it is equally distributed to a series of vertically arranged coils of seamless drawn copper tube of small bore. These coils discharge at their other ends into a similar header which is connected directly to the boiler feed pipe. Exhaust steam in the shell surrounds the coils. Connections between coils and headers are made with screwed ground union joints, without packing or gaskets. Ferrule parts of unions are securely brazed to ends of coils. Through a large door in front of shell a thorough inspection may be made without breaking a single pipe connection Could anything be simpler?

Write for free illustrated catalogue.

404 McKINNON BUILDING
TORONTO

H. L. PEILER
McLEOD BUILDING,

able Engineering Goods

A MONEY BACK GUARANTEE

goes along with every sale of

'France' Metallic Packing

France Packing is made entirely from the best anti-friction metals and it certainly gives the longest service of any packing made. When put on a good rod, France Packing is guaranteed to be perfectly steam, air, gas or ammonia tight, no matter how high the pressure. If it fails within three years we will cheerfully and promptly refund the purchase money. There's an enormous quantity of France in use to-day in practically as good condition as when put into active service 10 years ago.

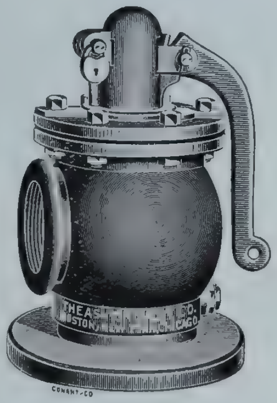
Get the Details Write for Free Catalogue.

Genuine 'Ashton' Valves

are the World's Standard

Wherever steam power is used you will find Ashton Valves giving active and entirely satisfactory service. Being perfectly automatic in operation, simple in design and construction, and having no parts liable to accidental derangement, they are unquestionably the most reliable safety valves made. And they save steam-waste, too, by means of the "pop" chamber feature.

Write us for our illustrated catalogue of Ashton lines.



'Mason' Reducing Valves

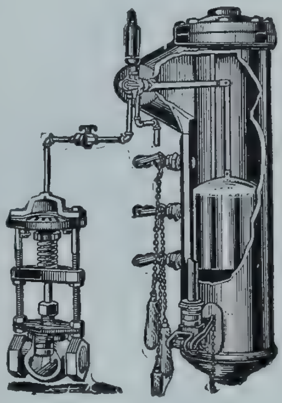
are always RELIABLE

Mason All-Bronze Standard Valves reduce steam or air pressure from 300 lbs. or under down to any desired low pressure. And the Mason Standard Reducing Valve is exactly similar in construction except that the large diaphragm is sufficiently sensitive for use under the lowest pressures, EVEN BELOW the ATMOSPHERIC PRESSURE.

Write us for free illustrated circulars showing the unbeatable Mason line of Regulators, Reducing Valves, etc.

The "Berry" Feed Water Regulator

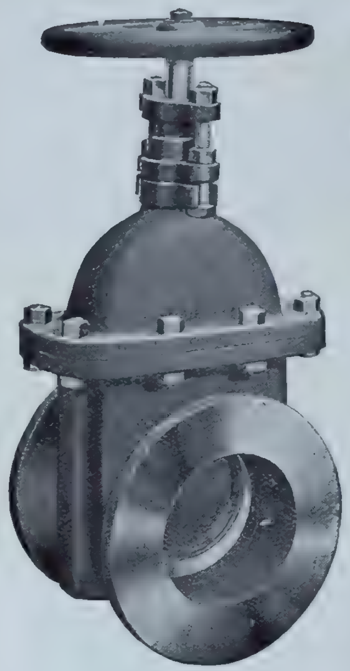
The Berry is entirely automatic and combines in one machine a perfect regulating device, a water column, and a high and low water alarm. Absolute simplicity marks the design and construction of the Berry---simplicity that means perfect safety and unfailing reliability. And its construction throughout is distinguished by the most perfect workmanship. Full particulars would be decidedly interesting to you. **Write us to-day for catalogue.**



& COMPANY

MONCTON, N.B.

52 ST. JAMES STREET
MONTREAL



Kerr Gate Valves

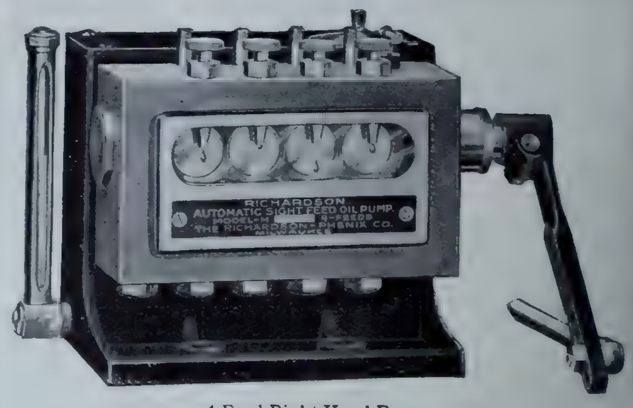
are to be found in all well equipped steam plants in Canada.

The valves with a good reputation are those you should buy.

Write for our Catalog of High Grade Brass and Iron Valves.

The
Kerr Engine Co., Limited
Valve Manufacturers
WALKERVILLE - ONTARIO

"The Aristocrat of all Lubricators"



4-Feed Right Hand Pump

RICHARDSON MODEL "M" MECHANICAL LUBRICATOR

Always specified where exacting service is required, and the science of economy is brought down to a fine point

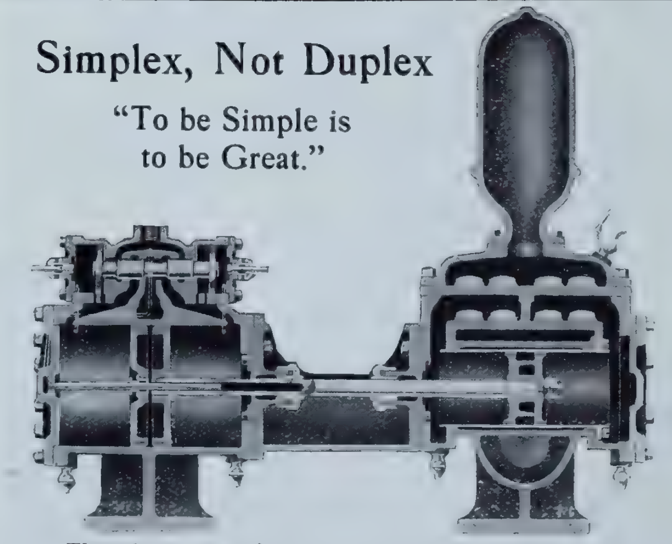
Better Lubrication with Less Oil

Richardson-Phenix Co.
"Everything for Lubrication but the Lubricant."
MILWAUKEE WIS.

Canadian Representatives:
Williams & Wilson, Montreal.
A. R. Williams Machinery Co., Toronto, Winnipeg, Vancouver.

Simplex, Not Duplex

"To be Simple is to be Great."



The above cut shows a sectional view of a Marsh boiler feeder. Note the extreme simplicity of construction and few wearing parts. With the exception of the piston itself, the steam valve is the only moving part on the steam end.

American Steam Pump Co.
BATTLE CREEK - - MICH.

CANADIAN AGENTS
A. R. Williams Machinery Co., Toronto.
Williams & Wilson, Montreal.
Stuart Machinery Co., Winnipeg.
Gorman, Clancey & Grindley, Ltd.,
Edmonton and Calgary.

MARSH PUMPS
FOR BOILER FEEDING

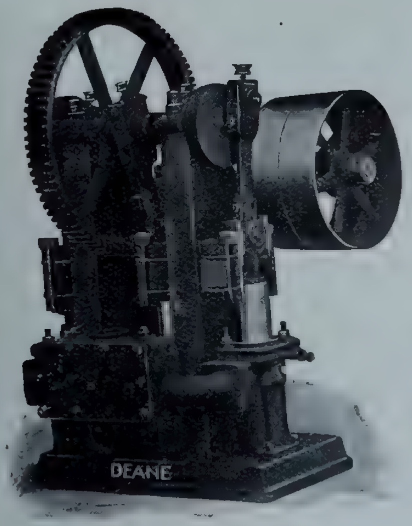
Built Expressly for Hard, Continuous Service.

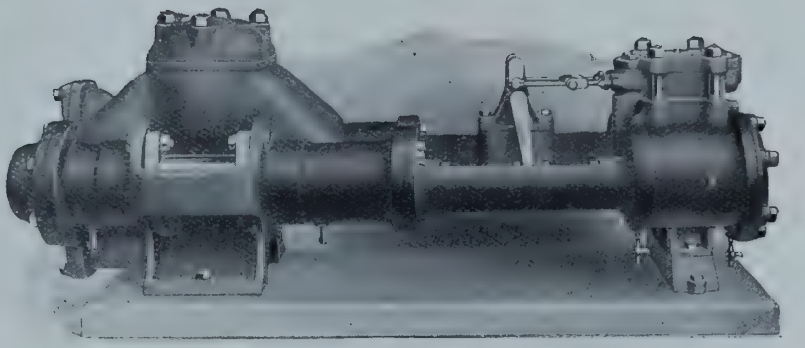
Marsh Boiler Feed Pumps are thoroughly bronze fitted at regular prices including solid bronze piston rods and removable bronze bushings in the water cylinders. They cannot short-stroke, race or pound and combine extreme simplicity with highest efficiency.

Write for our new 188 page catalog illustrating and describing our various pumps and their uses.

STEAM PUMPS

for every possible service





The Knowles Special Duplex centre packed Plunger Pump for Boiler Feeding, no Slippage.

Deep Well Pumps,
Artesian Well Pumps,
Hydraulic Pressure Pumps,
Duplex Pumps.

Water Works Pumps,
Power Pumps,
Boiler Feed Pumps,
Tank or Light Service Pumps,

Brewers' Mash and Beer Pumps,
Brewers' Water and Air Pumps,
Air Pumps for Acids,
Air Compressors,

Combined Boiler and Pump.
Elevator Pumps,
Special Fire Pumps,
Tannery Pumps.

The Blake Feed Water Heater has no equal.

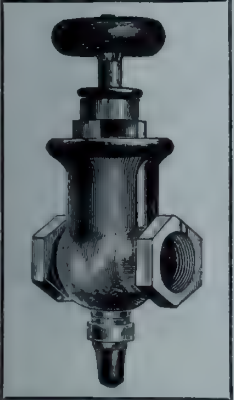
Pumping Machinery My Specialty

THERE IS NO USE DENYING THE FACT, that the Late Henry B. Worthington was the inventor of the Duplex D. A. Steam Pump, and to-day the International Steam Pump Co. consists of the Worthington-Blake Knowles-Deane Steam and Power Pump Co. Having been connected with Worthington - Blake & Knowles Steam Pump Co. for 40 years, and I am special agent for the sale of the Knowles Steam and Deane Triplex Power Pumps. The superiority of the same is acknowledged by copyists all over the world. Having been in the line of pumping machinery since 1851, and having a thorough practical experience in the pump line solicit a share of your pump trade. The Blake and Knowles are made in the Worthington shop, Harrison, N. J. Before you purchase send for catalogue and describe fully your requirements and I will quote you bottom prices for any pump you require.

WM. PERRY, Consulting and Hydraulic Engineer

Active Member American Waterworks Association.

Phone Up 568 ***848 Maplewood Ave., Mount Royal Ward, MONTREAL***



LOOK FOR "CURTIS"
On Your Engineering Specialties

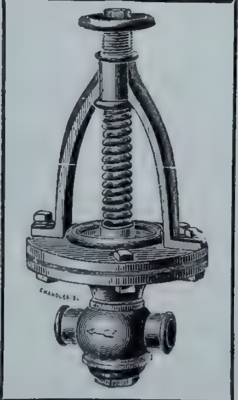
It is your protection against poor goods and poor service
See that you get it.

- Balanced Steam Trap
- Return Steam Trap
- Expansion Trap
- Separator
- Damper Regulator
- Temperature Regulator
- Improved Pressure Regulator
- Tank Governor and Pump

These and other specialties described in our catalogue.
Write for a copy.

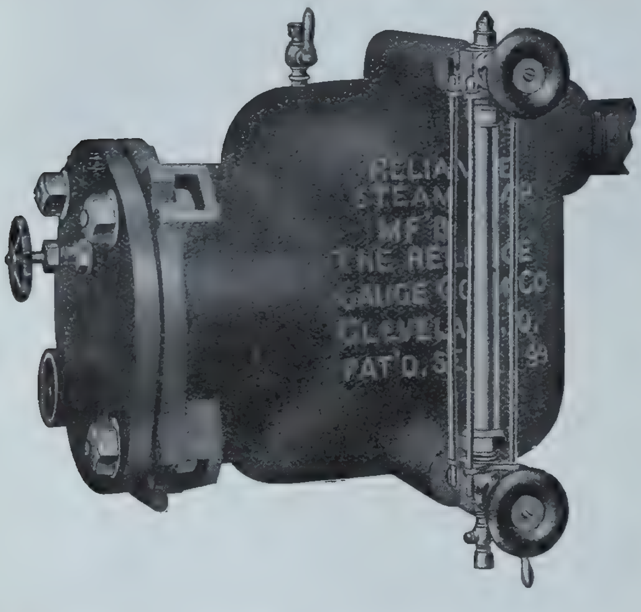
Julian d'Este Company

24 Canal Street : BOSTON, MASS.



The Engineer's Final Choice

Every Engineer who knows the value of reliability and absence of trouble in his Steam Trap will save time and tinkering around the plant if he is using the



"RELIANCE"

STEAM TRAP

The "RELIANCE" will handle every drop of condensation, whether it comes in driblets or in floods, and it has the added advantage of being simple in construction, with no parts to get out of order.

The "Reliance" is unlimited in capacity and practical in design, the valve being controlled entirely by the inflow of water with an action that is positive and never failing, working equally well on high and low pressure systems.

A simple turn of the hand wheel is sufficient when you wish to draw out the trap or blow out the sediment.

WE GUARANTEE EACH TRAP, INCLUDING THE FLOAT

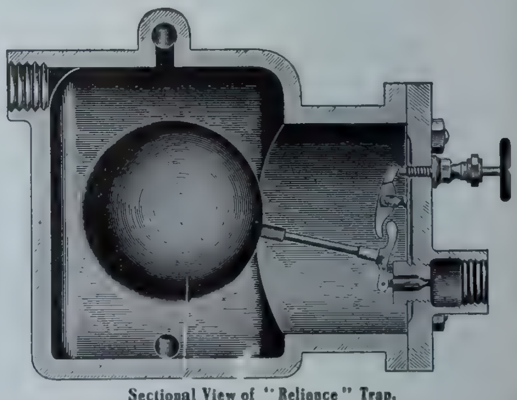
Write to-day for Illustrated Catalogue.

The Reliance Gauge Column Co.

5902 Carnegie Ave. - CLEVELAND, OHIO

Also Manufacturers of

Reliance Safety Water Column, Reliance Lever Water Gauges
Reliance Lever Gauge Cocks

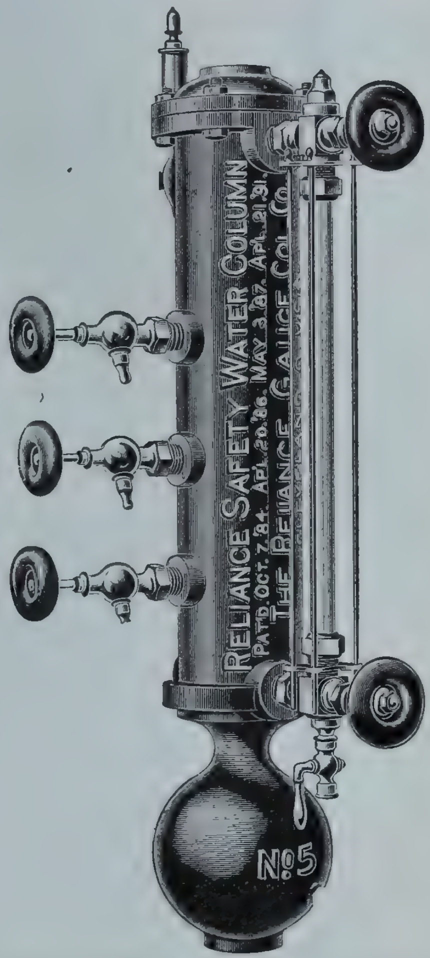


Sectional View of "Reliance" Trap.

Absolute Safety with Economy

In these days of modern inventions and perfected machines, no man does the work of a machine, if the machine can do it better and at lower cost.

And in your case, no fireman can watch so efficiently the water line of your boiler, and give the signal so rapidly when it gets too high or too low as the


RELIANCE SAFETY WATER COLUMN
PAT'D OCT. 7.'84. APL. 20.'86. MAY 3.'87. APL. 21.'91.
THE RELIANCE GAUGE CO.
No 5

"RELIANCE"

Safety Water Column

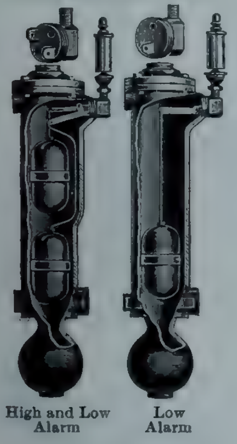
Whenever boilers work, day and night, the "RELIANCE" COLUMN works, and it never fails in its duty! It absolutely compels water to be carried constantly at its economical point, and it eliminates waste of fuel.

It does away with reduced steaming capacity and danger to the engine which always accompanies an overfed boiler, and it creates steady power, and a remarkable degree of safety from explosions.

The valves are placed high above high-water mark, where they cannot become clogged or get out of order.

The "Reliance" Column operates automatically, requires no attention, and gives a distinct alarm when the water falls below or rises above a certain level. If your boilers are not equipped with the "Reliance" Column, write us and we will make you an offer.

Showing Arrangement of Floats



Write us anyway for our Catalogue.

The Reliance Gauge Column Company

5902 Carnegie Avenue, CLEVELAND, OHIO.

Also manufacturers of Reliance Steam Traps, Reliance Lever Water Gauges, Reliance Lever Gauge Cocks

☞ **We would like to hear from reliable selling agents in Montreal, Toronto, Winnipeg Vancouver and other points, in reference to handling our lines in their territory.**

"THE Cyclone"

Shaking and Dumping Grate Bar

The Grate Bar that will generate more steam for fuel consumed than any other Grate in the world. And it is the only grate from which you can get the maximum results when burning the cheapest kinds of fuel (Soft and Hard Coal Screenings, Hard or Run-of-Mine Coal). The reason WHY? Because

THE "CYCLONE" GRATE allows 68 per cent. of air space and 90 per cent. underdraught. And by its improved shaking mechanism, the shaking is rendered very much more vigorous, and no ashes remain on the centre of the grate—the place where, in other makes, they usually are found to cling. This feature adds largely to the life of the grate.

The 'Cyclone' locks level, cannot get out of adjustment, and will never warp. We can show scores of letters from leading business houses appreciative of the virtues and economy of the 'Cyclone.'

Why continue using an inferior and less economical grate when the 'Cyclone' is at your service?

WRITE TO-DAY FOR ILLUSTRATED CIRCULAR

Canadian Steam Boiler Equipment Co.

Limited

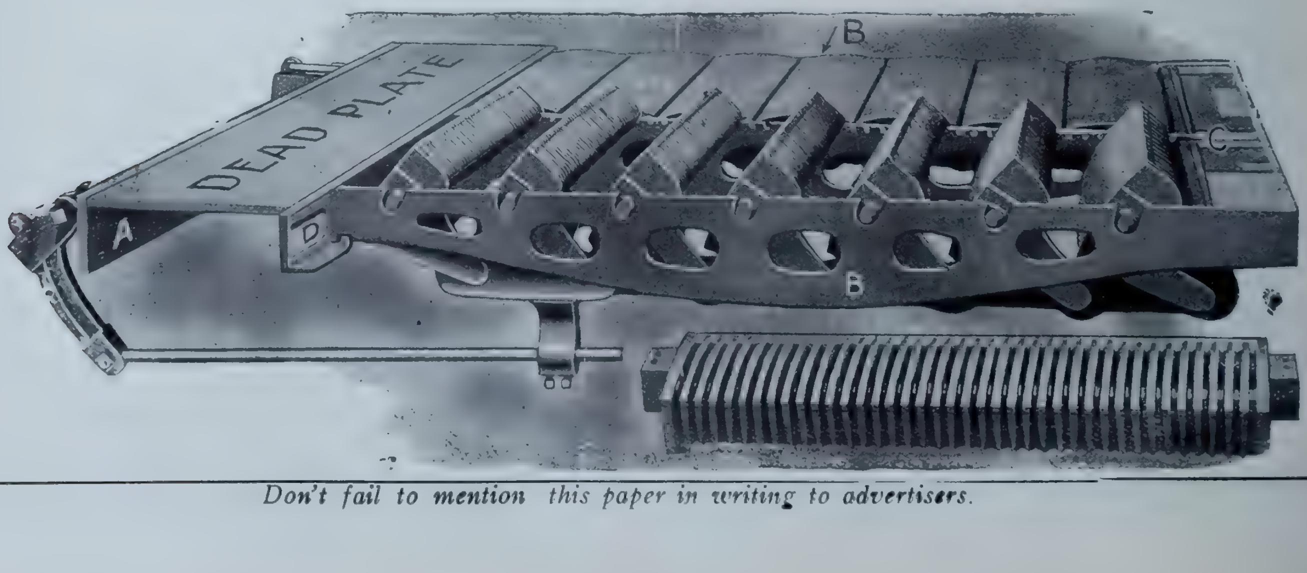
186 QUEEN STREET EAST, TORONTO

AGENTS

ST. JOHN, N.B.—F. W. BLIZZARD,
Canada Permanent Chambers.

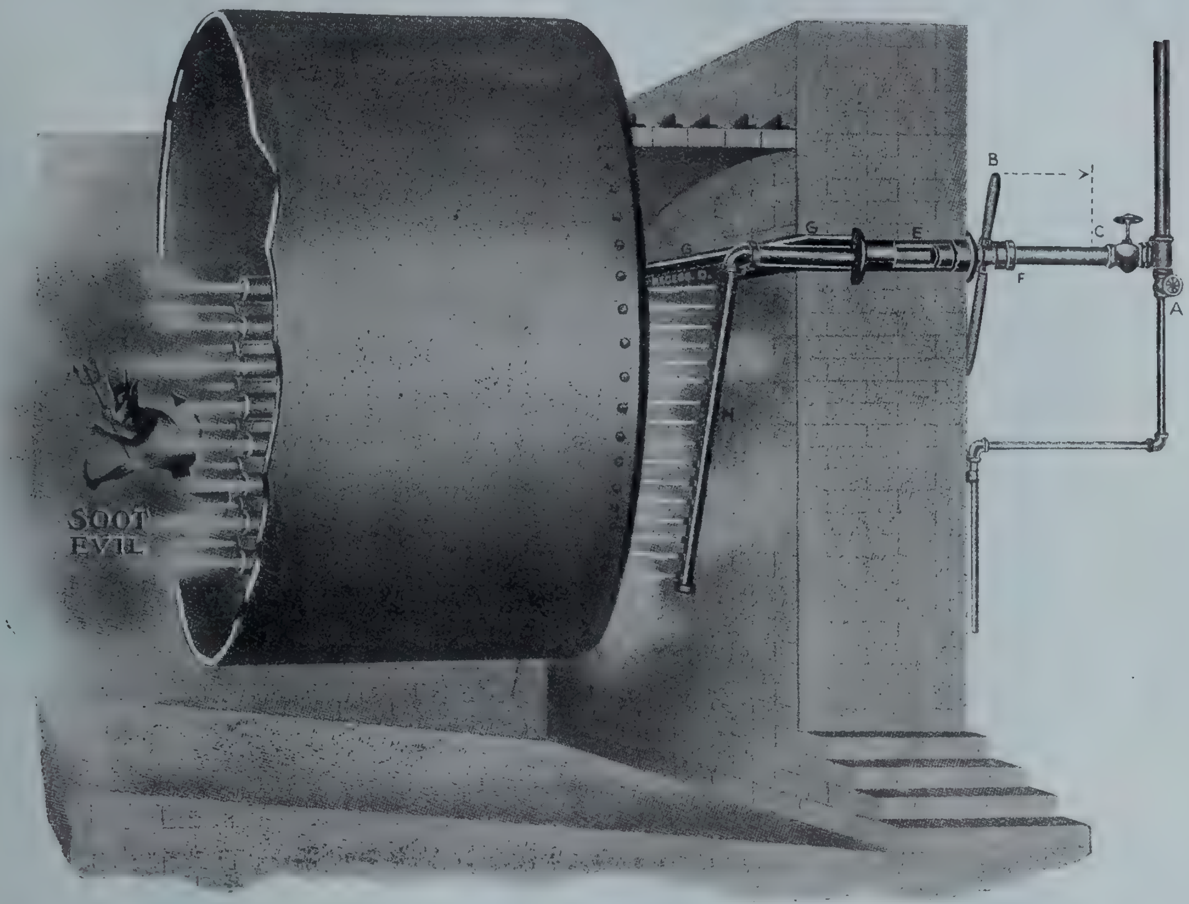
MONTREAL—JOHN G. ABRAHAM,
2844 Mance St.
BERLIN—J. HAINSWORTH, 14 Foundry Street.

HAMILTON—ROBT. FITZSIMMONS,
8 Grove Street



A CLEAN BOILER MAKES A NOISE LIKE A DIVIDEND

THE VULCAN PAYS FOR ITSELF IN SIX MONTHS.



THE VULCAN SOOT CLEANER

(OVER 5,000 IN USE)

as applied to the REAR END of a Return Tubular Boiler, throws direct concentrated blasts of dry steam into each tube and ***blows with the draft, while the smoke box doors remain closed. It will not burn out. This we guarantee.***

Installed on Thirty Days' Trial

MR. W. W. MARSHALL, Montreal, October 28th, 1910.
c/o The Vulcan Tube Cleaning Systems, Limited, City

Dear Sir,—The Vulcan Soot Cleaners with which our 200 h.p. boilers were equipped three months ago are proving satisfactory. We are highly pleased with them and are convinced that since this equipment was installed it has resulted in a saving in the consumption of coal.

Yours truly, THE N. K. FAIRBANK CO.,
John P. Atkinson, Manager.

Also adopted by the Grand Trunk Railway System, Standard Shirt Co., Dominion Textile Co., National Breweries Corporation, Limited, Montreal Cotton Co., Dominion Cartridge Co., Central Heat, Light & Power Co., Montreal Carriage Leather Co., Montreal Biscuit Co., Montreal Star Publishing Co., International Harvester Co., Macdonald Mfg. Co., Toronto, and many hundreds of others.

APPLICABLE TO ALL TYPES OF WATER-TUBE AND FIRE-TUBE BOILERS

Write for literature. We will gladly send it.

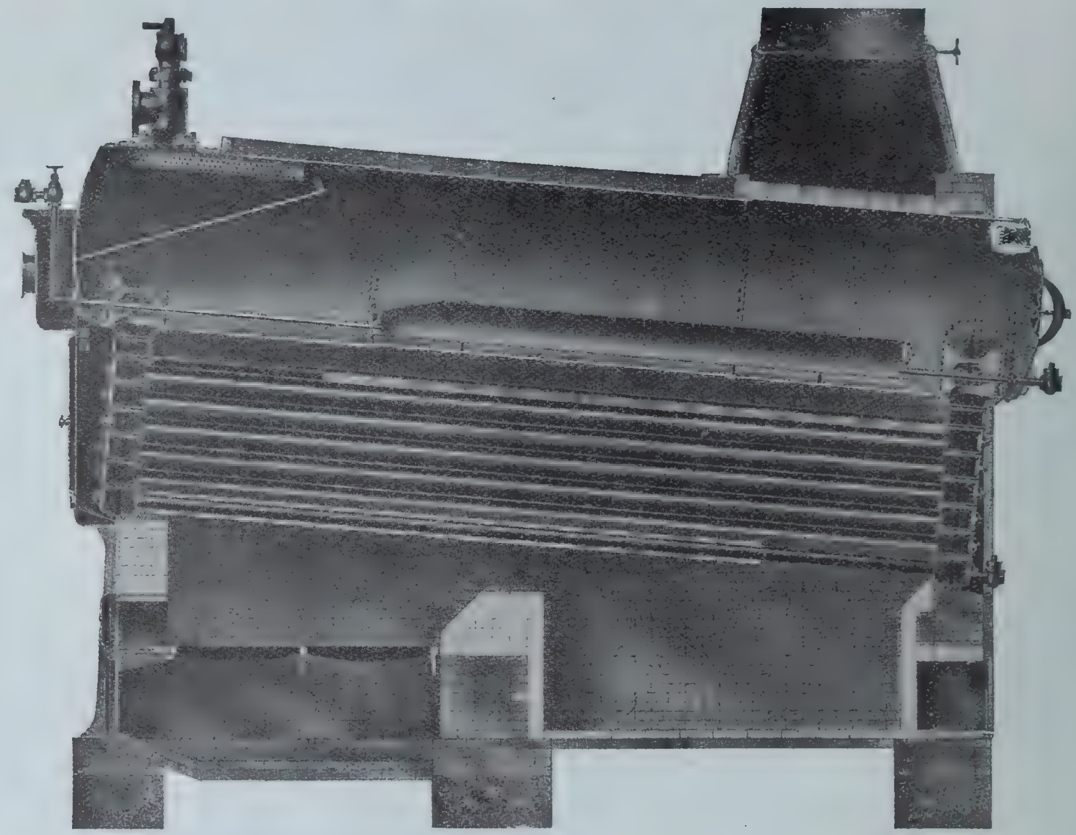
VULCAN TUBE CLEANING SYSTEMS, LIMITED

204 St. James Street - - - MONTREAL, CANADA

125,000,000 HORSE POWER OF

HEINE BOILERS

in use in United States at the present time



The reason why so many of the largest Power Plants in all parts of the world have installed the

Heine Safety Boiler

is because in point of efficiency, economy, durability and safety it is without a peer.

The HEINE BOILER is economical because it delivers dry steam at the piston by separating all water from the steam. Moreover, it has a wonderful capacity for absorbing and transmitting heat.

The HEINE DRUM is a specialty of this boiler, which effectively precipitates and discharges all scale and mud.

Absolute safety at the highest pressures is assured to users of the Heine Boiler. Every conceivable test is applied both to the plates, etc., and to the completed boiler.

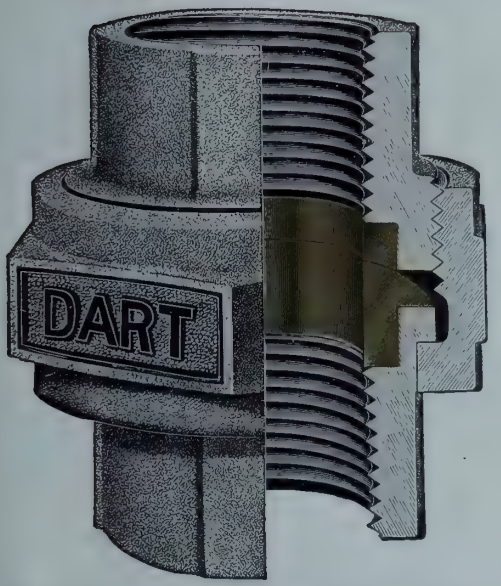
Write for our literature. It fully explains the HEINE claims to superiority.

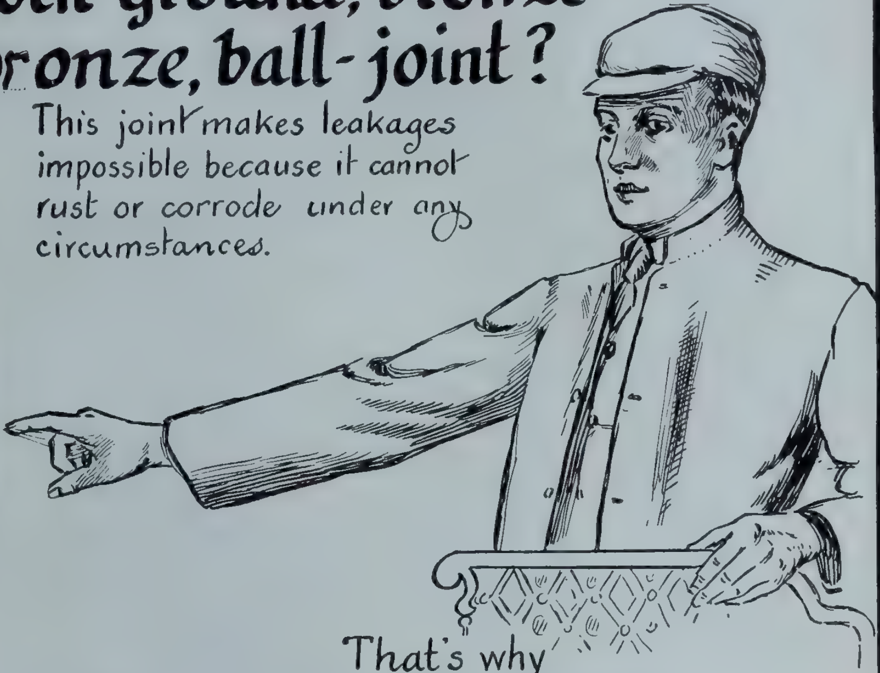
Write us to-day.

POLSON IRON WORKS, Limited
TORONTO, CANADA
Agents for Quebec—Watson Jack & Co., 709 Power Building, Montreal.

See that smooth-ground, bronze-to-bronze, ball-joint?

This joint makes leakages impossible because it cannot rust or corrode under any circumstances.





That's why

Dart Unions

are replacing every other method of connecting pipes

Put a Dart Union Joint on the meanest place you know of *That joint will never leak again.*

You can connect or disconnect Dart Union joints instantly, whether pipes are in or out of line. And you can do this time and time again.

No packing is required - just bring the two sections together, screw them up, and you have a joint that is perfectly tight against steam, air, water, gas and oil.

Think what a Saving in time, trouble and expense Dart Unions make possible for YOU!

Most Dealers sell them

Ask your Dealer

Dart Unions are made in screwed and flanged types, and sold under a guarantee that we will replace with two unions any one found defective.

Dart Union Co., Limited - Toronto, Canada

Are you wearing a Dart Union Watch-Fob? If not, write us and we'll send you one by return mail.

R

Type "K"

IRON BODY BRONZE MOUNTED

Gate Valves

Tested to 300 pounds hydraulic pressure.

Elliptical in design.

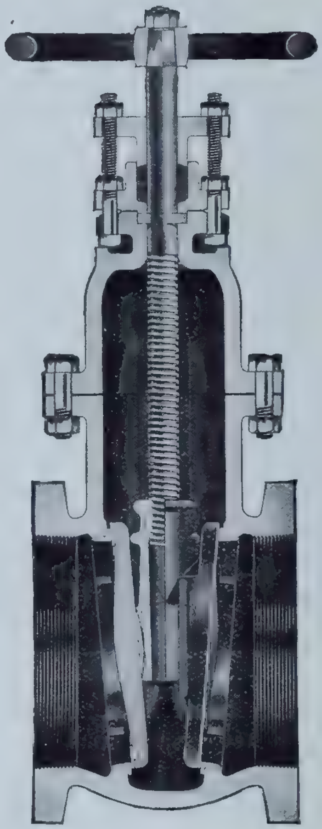
Double Compensating Bronze Faced Discs.

Can be re-packed while under pressure and wide open or closed.

Parts interchangeable.

Discs cannot jam.

Possess wide margin of safety.



Suitable for 125 pounds working steam pressure.

Design insures great rigidity and strength.

Heavy bronze seat-rings screwed into body and renewable.

Bronze disc-rings forced into double-grooved recesses in discs.

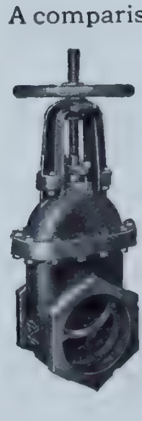
Can be operated in any position.

Handsome appearance.

Dependable in service.

A Thoroughly Reliable Gate Valve

A comparison with other Gate Valves is invited as regards design, material, workmanship and price

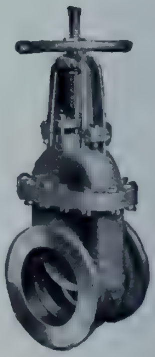


Stocked by Jobbers and Dealers everywhere.
Send for Type "K" Booklet.

Jenkins Bros., Limited

Sole Manufacturers

103 St. Remi Street - MONTREAL



YOU CAN'T GO WRONG

WHEN YOU
SPECIFY

LUNKENHEIMER
OIL and GREASE CUPS

THEY ARE MADE OF THE HIGHEST GRADE OF MATERIALS AND ARE VERY STRONG, PARTICULARLY IN THE SHANK, THE PART SUBJECTED TO THE GREATEST STRAIN.

JARRING OF THE MACHINERY TO WHICH THEY ARE ATTACHED WILL NOT SHAKE THEM TO PIECES, NOR WILL IT AFFECT THE SETTING OF THE FEED.

ALL CUPS ARE EASILY FILLED AND THE SIGHT-FEEDS ON THE OIL CUPS ARE LARGE, PERMITTING THE OIL TO BE SEEN FROM QUITE A DISTANCE, AND DO NOT EASILY BECOME OIL SPLASHED.

LUNKENHEIMER LINE OF OIL AND GREASE CUPS IS A VERY LARGE AND COMPLETE ONE, AND AMONG THEM CAN READILY BE FOUND A CUP PARTICULARLY ADAPTED TO SUIT ANY REQUIREMENT. "MOST SUPPLY HOUSES SELL THEM—YOURS CAN —IF THEY DONT OR WONT—TELL US."

THE LUNKENHEIMER COMPANY

Largest Manufacturers of High-Grade Engineering Specialties in the World

General Offices and Works: CINCINNATI, OHIO, U.S.A.

—BRANCHES—

CHICAGO	NEW YORK	LONDON, S.C.
32 Dearborn Street, cor. Lake	66-68 Fulton Street	35 Great Dover Street

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The EVERLASTING VALVE

PATENTED
Jan. 14, 1908

A Blow-off Valve that NEVER LEAKS

IT HAS A RECORD FOR LENGTH OF SERVICE THAT HAS NEVER BEEN EQUALLED. SEND FOR A BOOKLET.

S BRAND

NO STUFFING BOX

STRAIGHT THROUGH

S BRAND

QUICK OPENING

SELF GRINDING

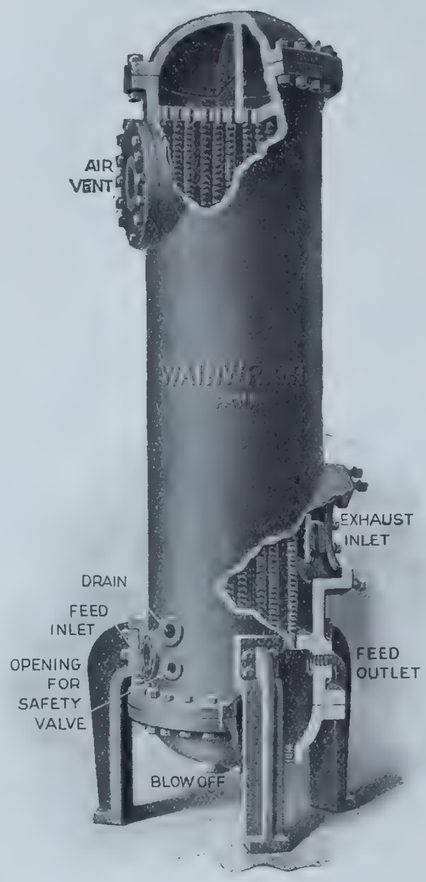
"SIMPLE AS A B C"

Manufactured and sold under Canadian patent by

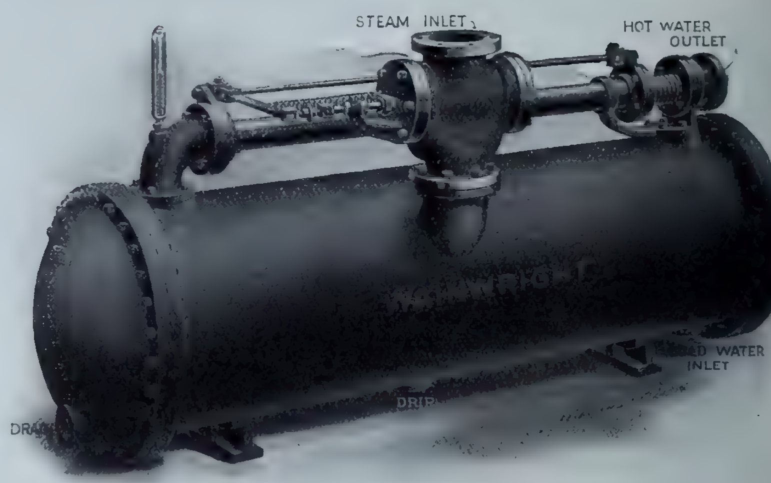
The Standard Fitting & Valve Co., Ltd.

Cast Iron Fitting Manufacturers - - GUELPH, ONTARIO

WAINWRIGHT



Feed Water Heater



Hot Water Service Heater

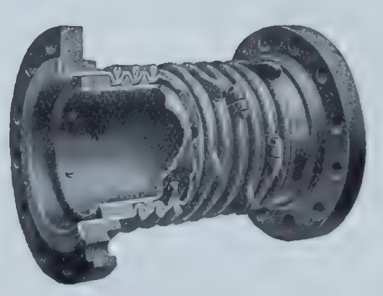
For the heating of water for Hotels, Laundries, Paper Mills, Bleacheries and other establishments. An apparatus unequalled in its field.

The chief feature of the WAINWRIGHT HEATER is the use of the straight corrugated copper tube. The agitation of the water in its flow through the corrugated tube insures a maximum rate of heat transmission ; further, it tends to keep the heating surface free from the collection of scale and insoluble impurities.

All differences in expansion and contraction between the tube and the shell are accommodated by the corrugations of the tube.

The heater is constructed throughout of cast iron with the exception of the heating surface which is of pure copper.

In the WAINWRIGHT EXPANSION JOINT all expansion is accommodated by the corrugations without any possibility of binding or of leakage.



High Pressure Expansion Joint

Alberger Condenser Co.

140 CEDAR STREET, NEW YORK CITY

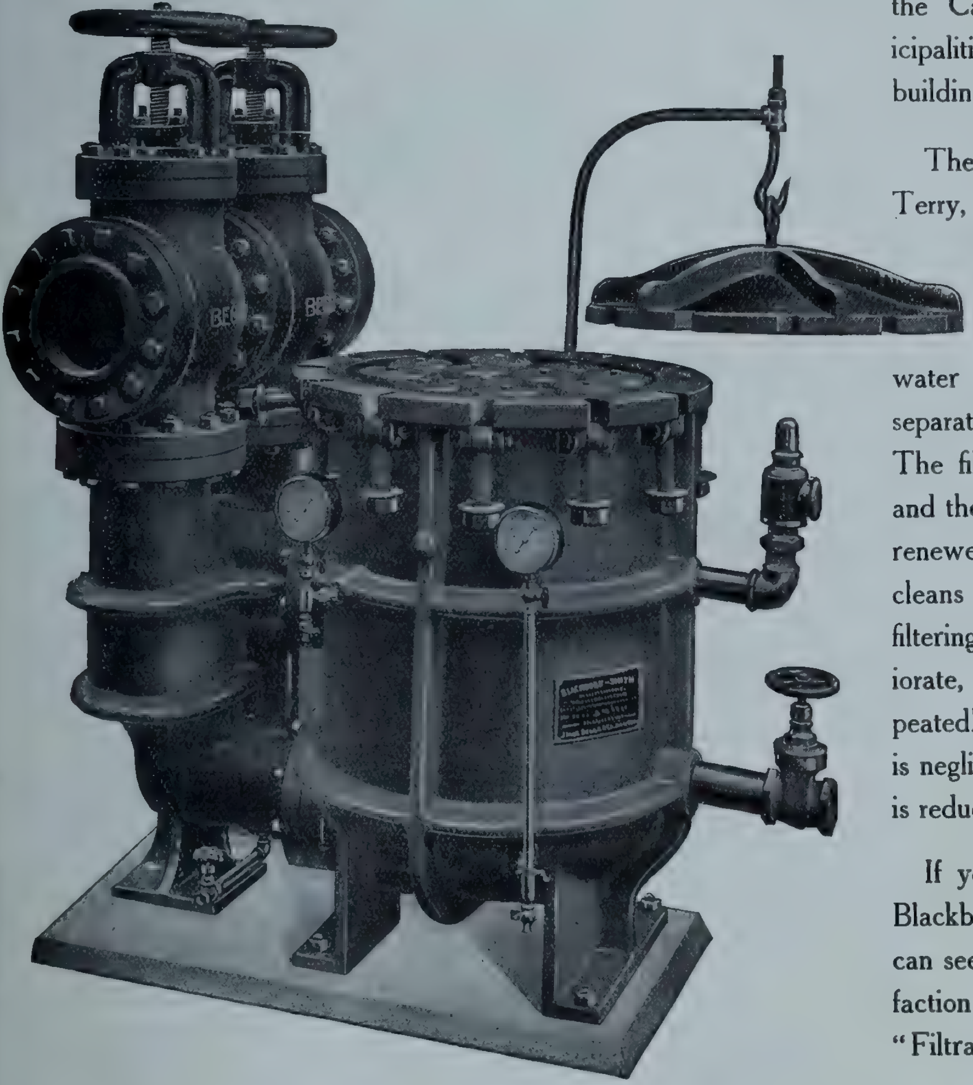
Representatives in Canada—THE CANADIAN FAIRBANKS CO., Limited

Montreal Toronto St. John, N.B. Winnipeg Saskatoon Calgary Vancouver

EADIE-DOUGLAS, Ltd., beg to announce that they are now Sole Canadian Sales Agents for the

Blackburn-Smith Feed Water Filter and Grease Extractor

manufactured by James Beggs & Co., of New York. This filter is in successful use in power plants of the Canadian Government, municipalities, manufactories and office buildings.



The filtering medium is linen Terry, long recognized as the most effective in retarding oil and other floating particles, and every drop of water is doubly filtered through separated layers of this medium. The filtering cartridges are small and the media easily removed and renewed. Ten minutes' work cleans the whole filter. The filtering efficiency does not deteriorate, the media can be used repeatedly, the expense of up-keep is negligible and the labor involved is reduced to a minimum.

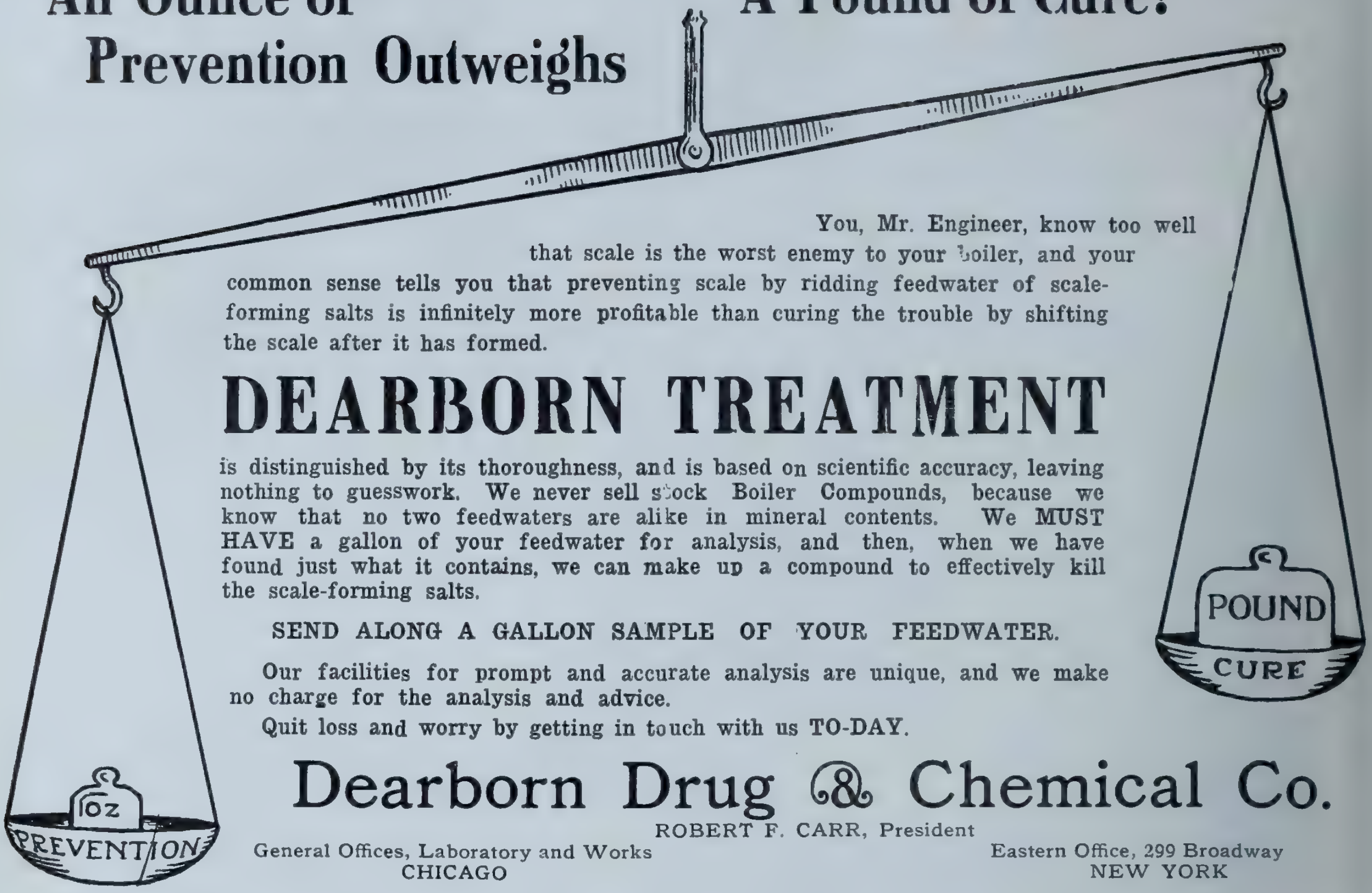
If you wish to know about the Blackburn-Smith Filter, where you can see it at work and what satisfaction it is giving, write for book "Filtration of Boiler Water."

EADIE-DOUGLAS, Ltd.

12-14 University Street - - MONTREAL

TORONTO WINNIPEG VANCOUVER OTTAWA QUEBEC

An Ounce of Prevention Outweighs A Pound of Cure!



You, Mr. Engineer, know too well that scale is the worst enemy to your boiler, and your common sense tells you that preventing scale by ridding feedwater of scale-forming salts is infinitely more profitable than curing the trouble by shifting the scale after it has formed.

DEARBORN TREATMENT

is distinguished by its thoroughness, and is based on scientific accuracy, leaving nothing to guesswork. We never sell stock Boiler Compounds, because we know that no two feedwaters are alike in mineral contents. We MUST HAVE a gallon of your feedwater for analysis, and then, when we have found just what it contains, we can make up a compound to effectively kill the scale-forming salts.

SEND ALONG A GALLON SAMPLE OF YOUR FEEDWATER.

Our facilities for prompt and accurate analysis are unique, and we make no charge for the analysis and advice.

Quit loss and worry by getting in touch with us TO-DAY.

Dearborn Drug & Chemical Co.

ROBERT F. CARR, President

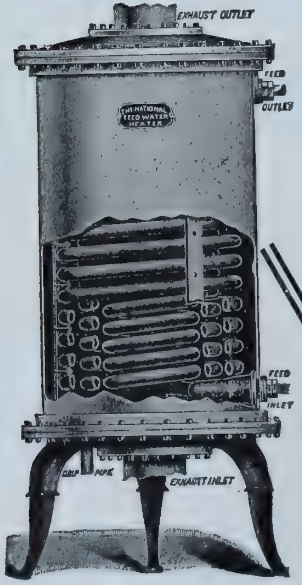
General Offices, Laboratory and Works
CHICAGO

Eastern Office, 299 Broadway
NEW YORK

The NATIONAL FEED WATER HEATER

THOUSANDS OF HORSE POWER IN USE IN CANADA

The reason more National Feed Water Heaters than any other make have been sold in the past twenty years is because they are more practical and efficient, and extremely simple in construction.



From one to fourteen coils of seamless drawn brass or copper tubing are encased in a cast iron or steel shell, to which ***exhaust steam*** is admitted, heating the water passing through the tubing. All joints are brazed and leaking is impossible. There is no pressure on the shell at any time, adding to its life.

There's an interesting National Catalogue yours for the asking. Send for copy to-day

The National Pipe Bending Co.

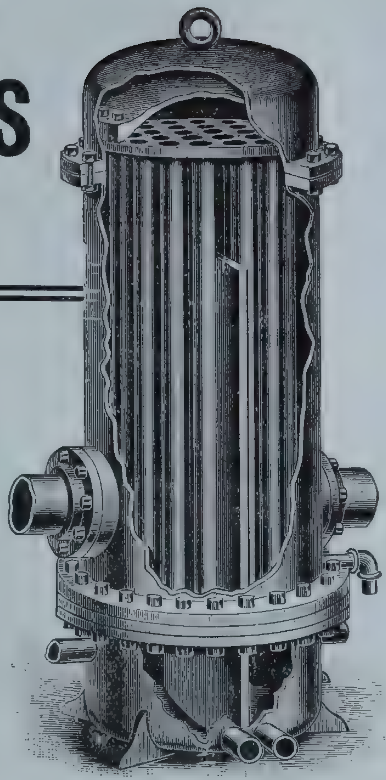
91 Lloyd Street

NEW HAVEN : CONN. : U.S.A.

Investigate the merits of the

JACOBS

Feed Water HEATER



The "Jacobs" will positively make use of the waste steam from your exhaust to the very best advantage; heating your feed-water to the boiling point.

It is easily the simplest, best constructed and most effective apparatus of its kind ever introduced. Fully guaranteed.

Send for descriptive circular.

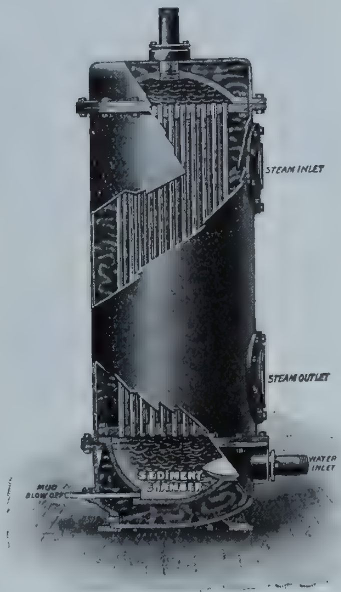
Chas. J. Jacobs & Co.

42 Olive Street, BOSTON, Mass.

Mackie Patent Heaters

"Made in Canada."

The tube portion of this heater is not attached to the shell. Allowance for free expansion and contraction makes it the most durable heater on the market.



Goulds Pump Company

National Trust Bldg.,
TORONTO

Coristine Building,
MONTREAL

Are You Using Your Exhaust Steam?

There is power in it which we can harness for you!

By means of the

OTIS Tubular Feed Water Heater Oil Separator and Purifier

You can heat your Feed Water to the boiling point without any back pressure.

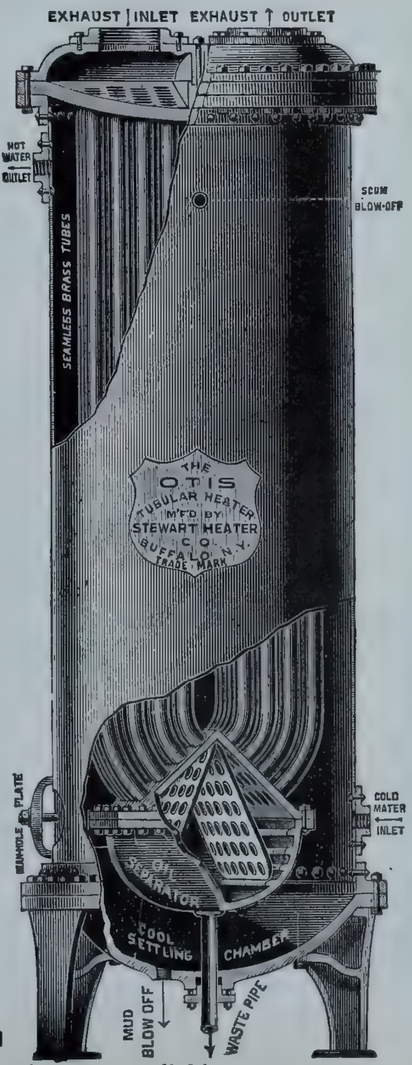
The OTIS will return the water of condensation from the heating system to the boiler without the additional expense of an eliminator, and will, moreover, extract the oil from the exhaust, so that the steam, after passing through the heater, can be used for other heating purposes.

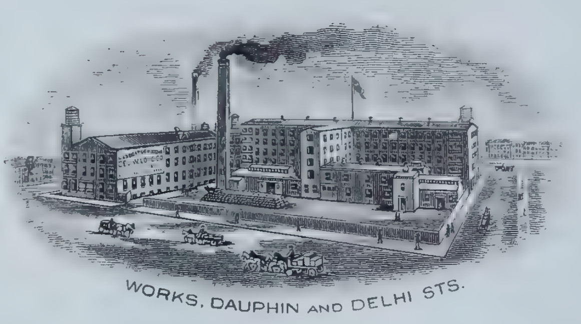
We pay all costs of a trial if the OTIS doesn't do all we claim for it.

Write to-day for Catalogue and Places

The Stewart Heater Company

189 Norfolk Avenue
Buffalo, N.Y., U.S.A.





WORKS, DAUPHIN AND DELHI STS.

WHAT DO YOU KNOW ABOUT YOUR FEED WATER

? ? ? ?

You realize that many waters form scale which costs time and money to remove or waste fuel if retained, that others contain acid, causing pitting and corrosion.

You MAY believe that your water is all right, but you can never be SURE until you have had a CHEMICAL ANALYSIS made.

This we will willingly make for you free of charge and without implied obligation...It is true that we have boiler compounds to sell, but we have grown to be the largest concern of our kind in the world, because WE HAVE NO "CURE-ALL COMPOUND" AND HAVE NOTHING TO OFFER UNTIL WE KNOW YOUR INDIVIDUAL NEEDS.

Then by the fixed laws of chemistry we are able to compound dry chemicals to positively eliminate any troubles that an analysis shows.

We guarantee this in writing on a "no cure, no pay" basis.

To be absolutely on the safe side send us via PREPAID EXPRESS a gallon of your water and we will gladly make a complete analysis without charge.

Other chemists charge up to $25.00 for this work. Use the coupon.

Geo. W. Lord Co.

2238-50 North Ninth Street
PHILADELPHIA, Pa.

Agencies in all other principal cities.

"Prevention is Better Than Cure."

An old proverb which was never so true as when applied to the *Scale Problem!*

Prevent the formation of Boiler Scale by treating your Feed Water with

POTATO SCALE BOILER CLEANSER

It will save fuel, keep your boiler from foaming and is guaranteed not to injure tubes, shell or connections. Send me one gallon of your *Feed Water* and I will forward a compound which I will guarantee to free your Boiler from scale and keep it free.

SOLE AGENT IN AMERICA:

C. C. SNOWDEN

All letters to Calgary. CALGARY, ALBERTA

Dont Waste Time

or expense cleaning scaly tubes! any money spent in preventing scale is a far more profitable outlay than what it costs to remove the scale after it has formed. Prevent scale by using

INTERNATIONAL
BOILER COMPOUND

But we can't work in the dark; we must find out what your feed water contains before we can mix the compound that will eliminate the scale-forming salts. Express us one gallon of your feed water; we will analyse it *free of charge,* and will forward a TRIAL SAMPLE of our compound guaranteed to banish all your Scale Troubles.

You can make money acting as our agent. Write for details of our offer.

Get in touch with us to-day.

International Boiler Compound Company

144-146 West Michigan St., Chicago, Ill., U.S.A.

The Compound that Really does kill Scale

Walker's Electric Boiler Compound

"REGAL" VALVE OIL

■

"RED STAR" CYLINDER OIL

■

"MONARCH" CYLINDER OIL

■

"SUPERIOR" ENGINE OIL

■

"VULCAN" MACHINE OIL

■

WRITE FOR PRICES

Every barrel of Walker's Electric Boiler Compound that leaves our warehouse is sold upon the unassailable record of REAL RESULTS ACCOMPLISHED.

We have never made a claim for this compound but what the compound itself proves true to the very letter.

We claim that Walker's Electric Boiler Compound will rid your boilers of ALL scale; and, if used regularly, will KEEP your boilers absolutely free from scale, without the slightest injury to the boilers or pumps.

That's Our Claim

Mr. Engineer---A claim that we back up with a cast-iron guarantee that your money will be refunded IMMEDIATELY if the compound fails to do its work as we say.

Now, just give this compound a fair trial and your scale troubles will soon become a thing of the past.

HEAVY RED MACHINE OIL

■

"BRUSH" DYNAMO OIL

■

GAS ENGINE OIL AND ALL ENGINE SUPPLIES

■

WRITE FOR PRICES

The Electric Boiler Compound Co., Ltd.

Guelph, Ontario

OUR GUARANTEE IS UNMISTAKABLE

A packing that is not safe against leakage and blow-outs, that scores rather than smooths the rod, and that is always in need of attention is expensive if you get it for nothing.

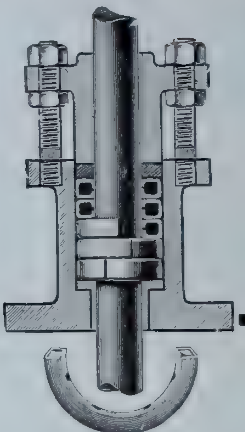
PREMDURO
FLEXIBLE METALLIC
PACKING

costs only a trifle more than soft packing, but it is good for years of service even on scored rods. With 'Premduro' there is no undue frictional heat, and no danger of the packing fusing or changing its composition, and it is guaranteed to maintain that easy steam-proof contact which enables an engine to do its best work.

OUR GUARANTEE—Your money back if not absolutely and entirely satisfied. May we send you samples?

Premier Engineering & Manufacturing Co.
25 Broad St., NEW YORK
The International Supply Co. of Montreal, Eastern Agents

We are open to appoint agents for Ontario and Western Canada. Write for details of our proposition.



HUHN PACKING

THE PACKING THAT LUBRICATES

The chief difference between HUHN PACKING and every other packing on the market is that

HUHN PACKING

is not only metallic, but a *self-lubricating packing*, and is in *direct contrast with all other metallic packings* which depend upon external lubrication.

It is equally efficient for use with Steam, Water, Air, Gas Acids, Ammonia, CO^2, Brine, Oil, Tar, etc.

Why not get into good company and use HUHN PACKING? You really cannot afford to be without it.

Write to-day for booklet and prices.

BAIN & MITCHELL
Y.M.C.A BUILDING - - - - MONTREAL

How's Your Packing?

Is it working right up to the limit?
If you are using "GARLOCK" it is.
IF NOT, LET US EQUIP YOU

YOU CAN DEPEND ON
GARLOCK PACKING

WRITE US REGARDING YOUR PACKING REQUIREMENTS

THE GARLOCK PACKING CO.
HAMILTON, CANADA

BE SURE YOU GET GENUINE "GARLOCK"

THE GARLOCK PACKING CO. TRADE GARLOCK MARK HAMILTON, CANADA.

THE TRADE MARK WILL TELL YOU

Put These in Your Engine

Just THREE rings of this Packing will pack your stuffing-box better than it has ever been packed before. And, too, it'll stay packed for months, likely a year, then, all you need do is to add ONE new ring to secure more service.

DANIEL'S ROD PACKING P.P.P.

is a scientifically-constructed Packing, which automatically adjusts the pressure on the rod to the requirement, whether that be 200 lbs. or but 5 lbs. Ordinary packings maintain a fixed maximum pressure, therefore, during over 75 per cent. of the rod travel there is an EXCESS of FRICTION on the rod.

FREE "The story of Some Friction Tests," the only treatise on Packings published, will be sent FREE on request. The book is profusely illustrated with photographs, drawings, indicator cards, etc, etc. Send a postal TO-DAY to Department, 24-K, and the Book will come by return mail.

Quaker City Rubber Co.

Philadelphia Chicago Pittsburg
New York, U.S.A.

THE FOSTER EXCESS BOILER FEED PUMP GOVERNOR

For Steam Driven Boiler Feed Pumps

MR. ENGINEER · Are you using steam driven boiler feed pumps? Don't you find your boiler pressure fluctuates from time to time due to local conditions---poor coal, bad firing or when cleaning fires?

WHAT WOULD YOU SAY? if we were to tell you, you can automatically control your feed line to your boilers within any desired excess pressure over your boiler pressure (10 or 15 lbs. or so), without regard to variable boiler pressure and without the necessity of constantly watching your pump or adjusting the throttle valve on steam line to pump, to meet variable boiler conditions, or any time going near this regulator? Simply allow this automatic feed pump regulator to care for boiler feeding under any and all pressure conditions, alone and unaided.

WONDERFUL! Is it not? Sounds like a fairy story, doesn't it?

WELL, WE CAN DO IT. Our new Excess Pump Governor does this work and more---does it perfectly, and it is "fool proof", too.

LET US SHOW YOU. Not a cent cost if the regulator fails to do all we claim for it! Get our printed matter. We are sole manufacturers of this Twentieth Century Wonder.

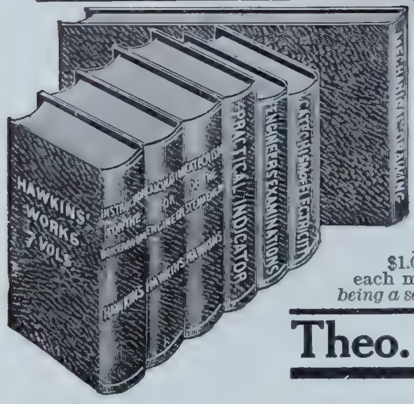
Made only by

The Foster Engineering Co.

Newark, New Jersey

Canadian Sales Agents:
THE CANADIAN FAIRBANKS CO., LIMITED
Montreal Toronto St. John, N.B. Winnipeg Saskatoon
Calgary Vancouver

HAWKINS' ENGINEERS LIBRARY.



Every Engineer, Superintendent, Machinist, Electrician or Power User should have the well known "Hawkins' Works" for study and ready reference. The seven books shown in illustration are the most complete and helpful works published for the practical man, convenient in size, and well bound, containing 2,268 pages, 5,171 ready references on engineering practice, 1,188 questions and answers, 444 standard rules, 1,258 illustrations and diagrams, making them a mine of the best and most reliable information obtainable. Sold on very easy payments as shown below.

SPECIAL OFFER Cut out and sign coupon, mark books desired (X). Any or all will be sent express paid upon receipt of $1.00 with order and agreement to remit balance $1.00 each month (*when complete set is purchased the price is $12, being a saving of One Dollar*). **Hawkins' Circular free on request.**

Theo. Audel & Co. 63 FIFTH AVE., NEW YORK.

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Please send me the books marked (X). I enclose $1.00 to cover first payment and hereby agree to remit $1.00 each month until paid.

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	HAWKINS' MECHANICAL DRAWING	$2
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	" STEAM BOILER PRACTICE	2
	" CALCULATIONS FOR ENGINEERS	2
	" STEAM ENGINE PRACTICE	2
	" STEAM ENGINE INDICATOR	1
	" CATALOG (free).	

Signature ....

Occupation ....

Where Employed ....
(*Firm Name*)

Home Address ....

Two Clean Boilers Cost Less For Fuel than One Dirty One

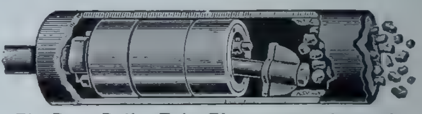
Scale not only plays havoc with your boilers, but makes big holes in your coal pile.
An engineer wrote us the other day he was saving over $4 a week on coal through the use o

The Dean Boiler Tube Cleaner

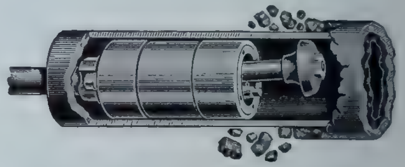
In other words, scale was eating up that many dollars' worth of coal before he used the Dean.
We can save YOU money and we'd like a chance to show you how.
Write for booklet No. 130 and our free trial offer.

The WM. B. PIERCE CO.

330 Washington Street, Buffalo, N.Y.
Montreal Office: 230 Coristine Building, Montreal



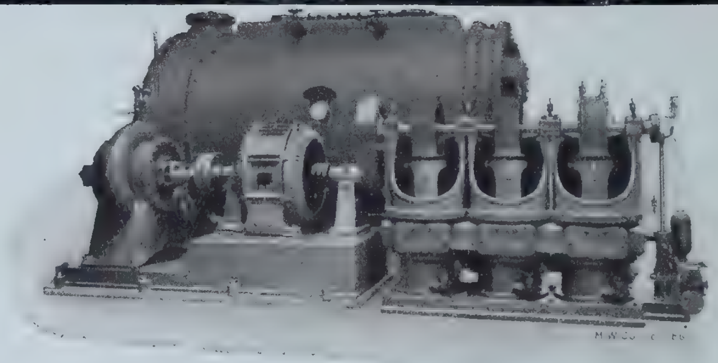
The Dean Boiler Tube Cleaner removing scale from the tube of a water tube boiler.



The Dean Boiler Tube Cleaner removing scale from the tube of a return tubular boiler.

Highest Vacuum
Special

Best Efficiency
Designs



CONDENSING PLANTS

OF EVERY DESCRIPTION

Barometric Low Level Jet or Surface

All on the Counter-Current Principle

"Edwards" Valveless Air Pumps Dry Air Pumps

The Canadian Boving Co., Ltd., 164 Bay St.

TORONTO

Vancouver Office: 427 Seymour Street. H. W KENT, Local Manager.

BELLISS & MORCOM

Quick Revolution Engines
Exhaust Steam Turbines

working in combination effect a saving in steam consumption quite unobtainable by Engine or Turbine alone.

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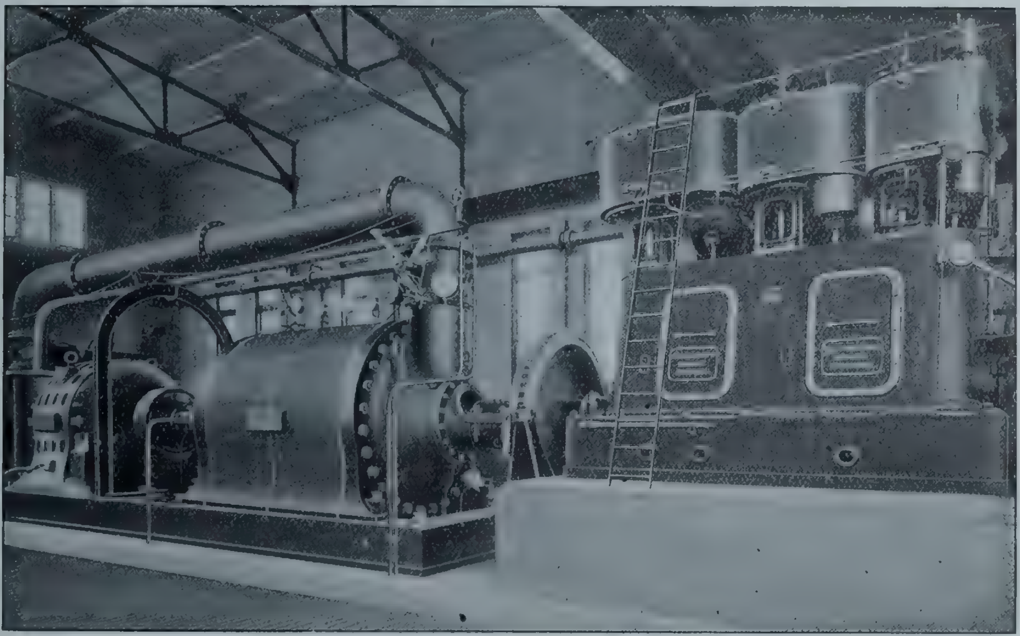

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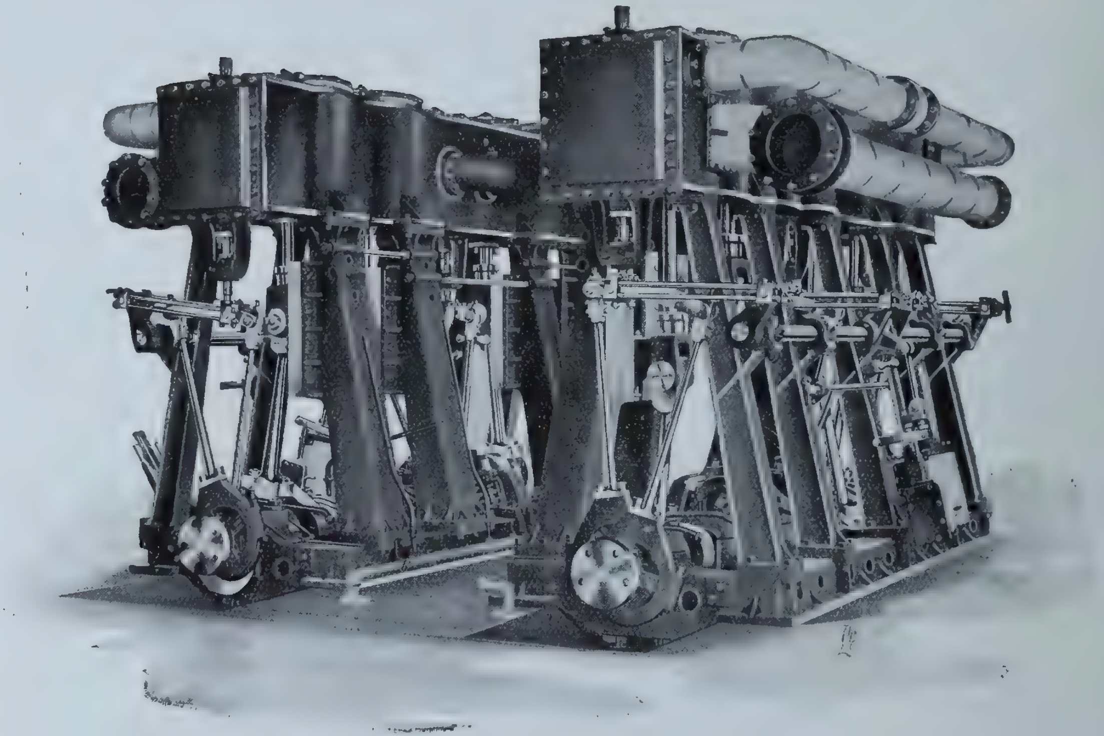

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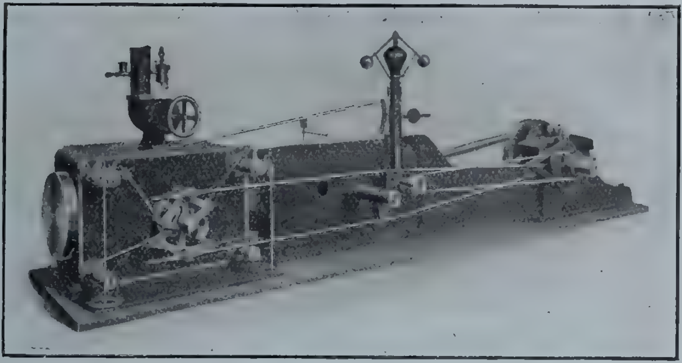

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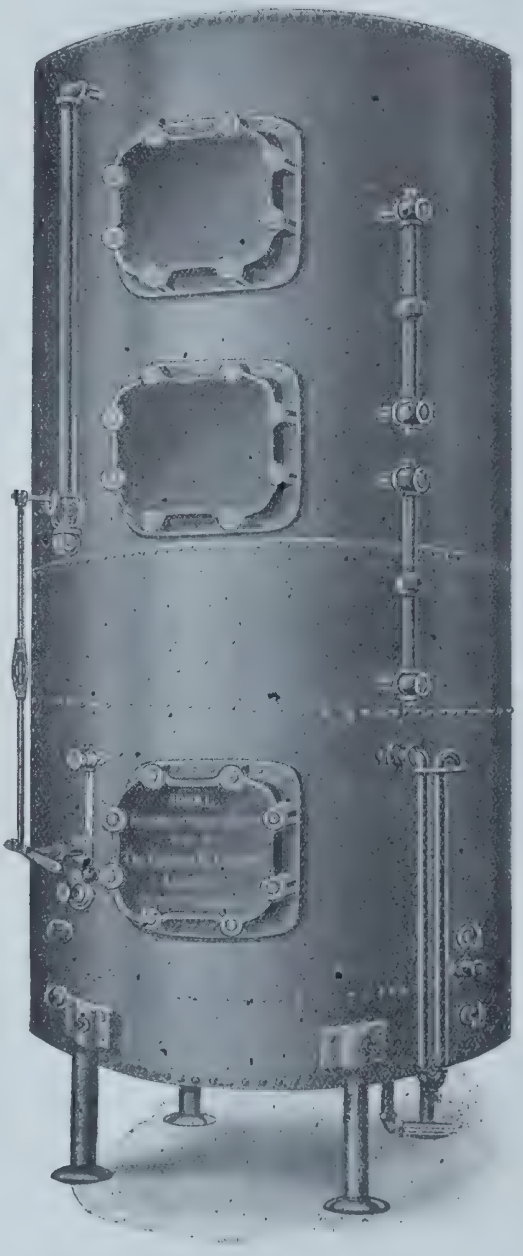

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Successfully Fighting the Many Steam Boiler Enemies

By the Editor.

The Object of Devoting a Number of Articles Especially to Boiler Feed Water in This Issue is to Assist the Engineer in Overcoming the Many Enemies of the Boiler to be Met With in the Boiler-room. Feeding and Purifying Water for the Boiler Cannot Help but be of Interest to Every Engineer, Who Must Wage a Face-to-Face Battle With the Corroding, Fuel-eating Elements That are Met in Boiler Practice.

AN Engineer's troubles begin when he opens an injector or turns the throttle of the boiler feed pump. Invariably the boiler scales up and the water tubes will fill up with scale and sediment *unless proper precautions are taken to eliminate the scale and incrustation forming elements.*

When the boiler begins to scale, more coal is necessary to keep up steam and the engineer has got to show the "boss" why it happens. The engineer must know *everything* about *Feed Water* and when the fuel-eating boiler begins to consume more coal than previously, the "boss" puts it up to the engineer. The engineer must be able to give the boss pointers about compounds, feed water cleaners, purifiers, softeners, etc. The articles in this issue will assist in keeping you informed on how to treat *Boiler Feed Water.* The advertisements are of special interest this month and the reader will find every page of interest. By a perusal of *advertising and editorial pages* the engineer will learn a great deal about *Boiler Feed Water.*

Cost of Compounds.

Some time since, Arthur D. Little, chemist of Boston, was called upon to study the conditions in a considerable number of boiler plants, with a view to *standardizing the methods of preventing boiler scale and reducing the expense thereof.* The following general abstract of his report will doubtless prove helpful to boiler owners and operators.

In a majority of the plants Mr. Little found soda ash and kerosene in use either alone or in combination with each other, while in several others a sumac compound was employed. The price of the latter was 10 cents per pound, its approximate composition being—

	Per cent.
Water	28
Insoluble matter	9
Sodium carbonate	43
Sodium phosphate	13
Organic matter (tannin)	7

Another mill was using a special compound costing only 2 3-4 cents per pound with an approximate composition of—

	Per cent.
Alkali	14
Insoluble matter	5
Water and organic matter	81

Still another mill was using a compound at 6 cents per pound, composed of—

	Per cent.
Water	10
Soda ash	53
Common salt	33
Organic matter	4

It was found that all the mills in the combination which used special compounds were expending nearly $1,300 per year for boiler compounds. Those which were using only soda ash and kerosene were expending very much less per horsepower although practically the same water supply was provided.

The method of applying the soda ash was investigated and it was found that in the case of a number of mills there was a mistaken idea of the use of a boiler compound. The methods employed in these mills, while differing somewhat in details, were to *add the soda ash once a week and clean the boiler. The true method was shown to be to add the soda ash in small quantity and continuously, and then keep the boiler in a condition so that by frequent blowing off it is kept clean.*

It was shown by Mr. Little that *a considerable saving could be made and a better result secured not only by reducing the cost of the compounds themselves but by keeping the boilers in first-class condition and preventing the formation of scale, thereby reducing the amount of coal required to produce the desired amount of steam.*

Purifying Feed Water.

A purifier will often result in a great saving and all methods should be carefully investigated. In a plant containing eleven horizontal return-tubular boilers, each rated at 80 horsepower and said to be generating altogether 1600 horsepower, a water-softening system in connection with an open heater using exhaust steam was installed. Previous to the installation each boiler was cleaned once every four weeks, the operation requiring the services or attendance of six men. *With the purifying system at work each boiler is cleaned once in every eleven weeks, the operation being performed by one man in a very short time. No hard scale forms in the boilers and only a very slight amount of sludge is gathered.* The amount of soda ash used is about 11 pounds per day, which is about equal to the amount of sulphate present in the water.

Waste of Fuel.

Besides lengthening the life of a boiler, eliminating any chance of blister, pitting or even explosion, proper treatment of *Boiler Feed Water* stops the *enormous waste of fuel.*

It seems hardly necessary to point out that a boiler *can't possibly do the same work when the tubes and plates are incrusted with scale or mud as when scale or mud is absent and the boiler is in "new" condition.*

Yet it is a fact that few power plant men seem to realize the tremendous loss occasioned by scale formation.

Just to give you an idea of how great is the loss of coal due to scale we need only ask you to note that one-sixteenth of an inch scale requires 13 per cent. additional fuel, 1-4 inch requires 38 per cent. more coal, and 1-2 inch calls for full 60 per cent. more.

Even with the increased fuel consumption there is a *great loss in boiler efficiency.* Yet cases are not wanting where entire tubes have been found to be filled with scale.

Proper Treatment.

It is entirely possible to remove, at a very moderate cost, all the impurities which, if delivered into the boiler, act to reduce its efficiency, shorten its life, and diminish its safety. Satisfactory apparatus or compounds for this purpose are manufactured by well-known engineering or chemical companies, *and there is no reasonable excuse at the present time for obliging any steam boiler to be fed with impure feed water.*

OPERATING HIGH-PRESSURE BOILERS.

The Fidelity & Casualty Co., New York, have issued the following rules:

1. On entering the boiler-room, ascertain if the valves between the boiler and water-column are open. Then blow down water-column, noting the return of the water in the glass, and test the gauge-cocks, until absolutely sure of the waterlevel. This should be done at the beginning and end of each watch.

2. Open each door to boiler at least once a day and look carefully for leaks at every possible point, noting tube ends, seams, and blow-off in furnace. Examine carefully the fire sheets for bulges, bags, or blisters.

3. Have all defects and leaks repaired without delay.

4. Safety-valves are liable to stick on their seats; they should therefore be raised carefully at frequent intervals. Attach a small wire cable to safety-valve lever, pass it over a pulley, and bring the end down to a convenient place for ready service in lifting the valve. See that the outlet to each and every safety-valve is full size of valve opening. When washing out boiler, oil safety-valve with cylinder oil.

5. When steam gauge indicates maximum load on safety-valve approved in inspection report, the safety-valve should be blowing off freely. If it does not, ascertain at once why not.

6. Keep gauge-cocks in good order and use them, as water-glasses are very unreliable. Place tees or crosses at the bend of both pipes from boiler to water column; remove the plugs and clean these pipes when washing out boiler.

7. In case of foaming, close the throttle long enough to show the true waterlevel in boiler. If the level is sufficiently high, feeding and blowing down will usually correct the evil. If foaming becomes violent, check the draft and use surface blow-off freely. Ascertain the cause of the foaming, and take the necessary steps to prevent the evil.

8. In case of low water, cover the fire with wet ashes, or with green fuel, if wet ashes are not available, and close the fire and ash-pit doors. Don't touch the safety-valve. Don't turn on the feed water under any circumstances. Let the steam outlets remain as they are until the boiler has been cooled off, and examine to determine what damage has been done.

9. When connecting boilers, exercise great care. See that the pressures on the steam-gauges agree before attempting to open the steam-valves. Open the valves very slowly, and, if provided with small by-pass valves use these before opening the large valves. Never connect boilers unless the steam pressures agree. Many explosions have been caused by neglect of these precautions.

10. Do not close the damper entirely when there is fire on the grates, as gas may collect and result in an explosion as destructive of property as a boiler explosion.

11.—Provide a "V"-shaped brick pier or asbestos cover to protect the blow-off pipe from direct flame in furnace. Have this pipe extra heavy with malleable elbow. Once or twice a day blow down about two inches of water. The best times to use the blow-off are the first thing in the morning and directly after the noon-hour, on each occasion before starting up; the circulation has then been retarded for some time and the scale-forming matter has had opportunity to settle near the blow-off. Open and close blow-off cock slowly to avoid water hammer.

12. Keep the boiler dry on the outside, as moisture will cause external corrosion.

13. Keep the brickwork tight so that cold air does not enter, as it will cause fuel losses. Fire lightly and frequently and endeavor by all means to save fuel for your employer. Endeavor to carry a uniform waterlevel when boiler is in service. Keep the feed-pumps, injectors, and all other appliances in good working order and as neat as possible.

14. Wash out boiler at least once every month and more often if feed water is bad. Do not allow mud or scale to accumulate in boiler, and do not allow oil or grease to enter boiler; these foreign substances may cause overheating and burning of plates and result in a bag, rupture, or violent explosion. A solution of soda ash or a small quantity of kerosene fed continuously into boiler is often beneficial in preventing or softening scale; when these substances are used open blow-off cock once or twice a day as in rule 11. If kerosene is used, great care must be exercised to see that it is entirely gotten rid of by allowing a draft to blow through the boiler before bringing a naked light to the boiler or allowing anyone to enter the boiler, as an explosion may ensue or the fumes may overcome the person entering.

15. When a boiler is to be cleaned, allow the fire to die out, and leave the dampers open with fire-doors closed for at least twelve hours, when the steam-gauge should indicate no pressure. Then admit air on top, open blow-off cock, and allow the water to run out. Remove the upper manhole plate, and use vigorously a large hose with ample water pressure to dislodge loose scale, and wash out the boiler thoroughly. Now remove the lower manhole plate and all the hand-hole plates, and entering the boiler remove the lodged scale at the turn of the flanges and below and between the tubes. See that all parts of the boiler are entirely free of scale and clean internally and externally from head to head, and see that the furnace is cleaned out from end to end. Examine carefully all parts of the boiler for defects, particularly the parts that are subjected to the direct heat of the furnace. See that any leakage at tube ends, or elsewhere, is stopped immediately, and that any tubes found bagged, or any other defects, are repaired at once.

16. Have all steam gauges tested by the inspector. The gauges should be placed on siphons and attached so that they may be readily taken down for test.

17. The inspection of a steam boiler is a matter of vital importance. When notified to prepare a boiler for internal inspection, proceed to cool down and clean the boiler as per instructions given in rule 15. Remove all scale, clean out the ashes and soot on the grates and in the combustion chambers, and sweep off the plates, heads, and tubes, so that every part of the boiler may be examined and its exact condition determined. Have the boiler cold for the inspector when he arrives. Have the steam gauge ready for testing, water-column connections open for inspections, and everything in readiness to facilitate a thoroughgoing inspection of the boiler and all its connections. Careful compliance with this rule will protect your employer's interests and your own also.

The British firm of Vickers Sons & Maxim, Ltd., Barrow, England, has erected an interesting apparatus for testing propellers for aeroplanes and airships. The apparatus consists of a horizontal cantilever 165 feet long, mounted on a cast-iron pedestal. At the end of the cantilever is placed a 100 h.p. electric motor connected by gearing to a propeller shaft, which runs at velocities varying from 500 to 1,000 revolutions per minute. Directly above the pedestal, a place is provided for taking the observations. The cantilever rests on a ball-bearing at the upper end of the pedestal. A velocity of 70 miles per hour can be obtained at the outside periphery of the cantilever. On account of the long radius of the circle in which the propeller is moving, the circular arc at every point coincides nearly with a straight line, so that the experiments made give practically the same results as if the propeller were used directly in an aeroplane or airship. Owing to the circular motion, the effect of the wind is neutralized, and a very accurate comparison between different kinds of propellers can thus be made.

Water Softening in Connection with Steam Raising

By Maurice A. Wood

This Article has Been Prepared by One of Our Regular Contributors From England, One Who is Competent to Discuss This Matter in an Intelligent, Authoritative Manner. There is a Very Intimate Relation Between Soft Water and Quick Steam-raising, Using a Minimum Amount of Coal. Processes are Here Described Which May be Made Adaptable to any Industrial Power Plant. Thousands of Dollars are Saved by Softening Water, and Examples are Here Given to Prove That This is an Actual Fact.

CHEMISTRY text books tell us that water consists of hydrogen and oxygen, in the proportion H_2O, but unfortunately for us all, it is only rain-water which approaches this high degree of purity. All other natural waters contain impurities of various kinds which may be either held in suspension or in solution; curiously enough it is generally true that the former class are organic matters, while the latter are inorganic.

It is natural that as water is used so largely for domestic purposes, the visible organic impurities have, in the past received most attention, with the result that at the present time public water supply authorities take measures to insure a very high standard of purity by means of filtration. Such measures, however, do not eliminate the inorganic impurities, and it has been the misfortune of the steam raiser and boiler user to realize the inherent drawbacks attaching to the use of impure water, and to evolve the steps which are now generally taken to remove dissolved impurities.

The day still seems very far distant when public supply authorities will undertake a really efficient and complete system of purification, although such a step is highly desirable from the point of view of the public health alone. In the meantime manufacturers and leaders of private enterprises have got to shoulder this burden, and the following pages are intended to present the complete problem and its solution in a brief form, from the point of view of the larger user of water for steam raising purposes, and to plead for a consideration of the matter in order to increase our industrial efficiency.

Degree of Hardness.

Waters containing a certain proportion of inorganic matter are called "hard waters," and the process of purification is termed "water softening." To measure the amount of hardness an arbitary term is used, the "degree of hardness," which is defined as a solution of one part by weight of inorganic salts in 100,000 parts of water. There are, however, other definitions in other countries. Well waters may go up to 50 or 60 degrees of hardness, and it may be said that the water supplies of the British Islands vary between 2 and 30 degrees, 15 to 20 degrees being the average. Water may have either "temporary" or "permanent" hardness, the first sort being due to the presence of carbonates of lime and magnesium taken into solution by the aid of the CO_2 absorbed by the water from the soil, while the second is due to the presence of sulphates, chlorides, and nitrates of lime and magnesium dissolved by the water itself. When temporarily hard water is boiled the CO_2 is liberated, and the carbonates are precipated, but in the case of permanently hard water the suphates and chlorides and nitrates, being soluble in water alone, do not precipitate when the CO_2 is driven off. These sulphates are only precipated at a temperature of about 300 degrees, and as this is often exceeded in steam boilers, it is easy to see that such precipation is the beginning of trouble for the user of boilers.

When hard water is evaporated in a boiler, the impurities form a scale of salts of lime, etc., upon the shell and tubes of the boiler, the rate of this incrustation depending on the degree of hardness. Take the case of a 200 H.P. engine which might require 2,000 gallons of water evaporated per day; if the water contained 15 grains of lime salts per gallon, scale would be deposited at the rate of 4 lbs. per day. This scale not only represents a dead loss of money in the shape of the cost of its removal, but it also means an addition to the coal bill due to the thickening of the boiler plates with a bad heat conducting medium.

Professor Rankine has stated that the resistance to heat of lime sulphate is 48 times that of steel boiler plates, while that of lime carbonate is 17 times, and it has been ascertained by tests that, whereas the temperature of a clean boiler plate is from 350 degs. to 400 degs. F, that of a plate with ½ of an inch of scale may be more than 750 degs. F. The fabric of the boiler is therefore subjected to excessive and unnecessary heat with the result that a very great strain is put upon the steel plates and tubes.

Increased Coal Bill.

In connection with the increase of the coal bill Professor Lewes has estimated that 1-6 in. of scale leads to 16 per cent.

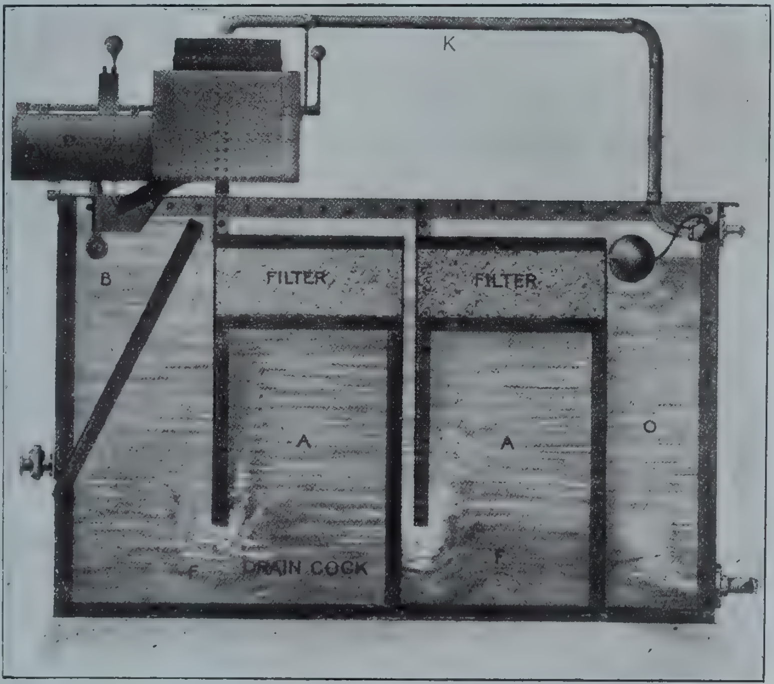


Fig. 1.

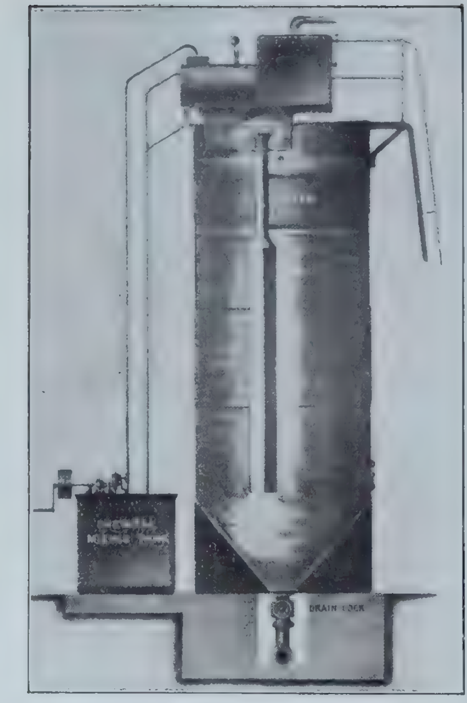


Fig. 2.

more coal having to be burnt, while ¼ in. leads to 50 per cent. more, and ½ in. to 150 per cent. more coal. This means that a coal bill of $10,000 a year say, may easily be transformed into a bill of $12,500, all for want of a few simple and inexpensive precautions, and the expenditure of a small amount of capital which will most likely be paid back in a couple of years through the savings effected.

Then there is the undoubted fact that very often additional boilers have to be installed simply to make up for the evaporative power lost in the others, by reason of their efficiency being impaired by incrustation.

Waters containing magnesium chloride cause great trouble as, at the high temperatures and pressures prevailing in boilers, hydrochloric, and even nitric acids are formed, with the result that there is corrosion and pitting of plates, seams and rivets.

Cost of Removing Scale.

With regard to the cost of removing scale and cleaning boilers, a couple of men may easily be occupied a week on such a job, at a cost of perhaps $25, and this expense may recur every 6 or 8 weeks. Many excellent devices are on the market for faciliating the removal of scale, especially from water tube boilers, but it is a better policy to spend money on prevention than on removal. Periodical cleanings are, at the best, only safeguards; they do not insure cleanliness., nor do they prevent deterioration of the boilers, which culminates in the premature scrapping of valuable pieces of apparatus. This shortening of the life of boilers is a very serious item in the depreciation account.

Thus we see that the effects of the use of hard water are:—

1. An addition to the coal bill of from 10 per cent. to 100 per cent., and to the wages bill a proportionate amount.
2. An unnecessary strain on the boilers.
3. A disintegrating action due to the different expansion of the plates and the scale.
4. A possibility of corrosion in certain cases.
5. The need for extra boilers to make up for the evaporated loss.

Everything points to the fact that the one and only true solution of the problem is to remove the inorganic impurities from the water before it enters the boilers, to turn the hard water into soft water. Hence the processes now resorted to are termed "water softening." In every case the comparitive costs must be examined of a water softening plant and its charges and of the maintenance, extra coal and other items attending the continued use of hard water. It is safe to say that in 99 cases out of 100 the case in favor of the installation of a water softener will be proved sufficiently well as to satisfy the most prejudiced.

Fig. 3.

The cost of water softening naturally varies a little in every case as it depends on the analysis of the water used.

A case is on record where a water of 52 degrees of hardness was softened down to only 2½ degrees at a cost of ¼ cents per 1000 gallons Very roughly the cost may be said to vary between ¼ and 16 cents per 1000 gallons, depending on the exact process adopted and upon the degree of hardness. It is frequently only a quarter or a third of the cost of treating with boiler compositions. According to Mr. Archbutt Deeley, one of the pioneers of water softening, 1 lb. of lime per 1000 gallons of water will remove 10 degrees of temporary hardness, while 1.6 lbs. of alkali will remove 10 degrees of permanent hardness. If we assume that lime costs $5 per ton and alkali $25 per ton, the cost of chemicals for softening is as follows:—

	per 1000 gals.
For every ten degress of temporory hardnes	.22
For every ten degrees of permanent hardness	1.90
Labor and interest on softening plant	10 to .14

Examples of Savings

Examples of financial saving from actual practice are always of interest, and appeal more to the prospective user than pages of theory. Here is an actual case from a steel works in America. The boilers at this place aggregate 3.000 H.P., and evaporate about 100,000 gallons of water per day. As the water, which is taken from a creek, contains 26 grains per gallon of mixed sulphates and carbonates the former predominating, the total amount of scale which used to be reposited reached the immense total of 70 tons per year. The results following upon the installation of a softening apparatus are given in a tabular form below:—

Before Softening.

Coal per annum	$38,350
Wages for cleaning	700
Boiler repairs	1,000
Chemicals	
	$40,050

After Softening.

Coal per annum	$28,800
Wages for cleaning	50
Boiler repairs	250
Chemicals	650
	$30,150

The saving of $10,000 easily covered the cost of the softening plant in the first year. Added to this is the increased capacity of the plant and its lengthened life.

The chemistry of water softening is extremely interesting, and should be thoroughly understood by all users of water for industrial purposes. The first thing to do is to remove the free CO_2 which the water has absorbed from the earth and the atmosphere, and no process is of the smallest use which does not do this effectively. Although the CO_2 can be removed by boiling the water, it is far cheaper to use lime for this purpose. There is a considerable difference of opinion as to whether it is better to use lime water or milk of lime, and manufacturers of water softening apparatus generally advocate to the conclusion of all else the particular process of the two which they happen to use, to the consequent confusion of the prospective purchaser.

Lime Water.

Mr. Paul, the well known chemist, is of opinion that milk of lime is best, owing to the fact that it can be used in great strength, can be mixed with the necessary amount of soda, and thus simplifies the softening process. Lime water being 1-100 the strength of lime milk, on the other hand, has to be used in larger quantities, and is slower in its action, besides being somewhat difficult to make satisfactorily on a large scale. Being a thin liquid, however, it has no tendency to choke valves and outlet pipes, as milk of lime may seem to have. It is also easier to accurately measure a large quantity than a small one. Having estimated the CO_2, the sodium carbonate which is added to the water destroys the hardness by removing the bases of the soluble salts of lime and magnesium, leaving in their place the sulphates, chlorides, or nitrates of sodium in the case of permanently hard water. In the case of temporarily hard water, the carbonates are entirely removed. By these means it is possible to soften water down to one degree of hardness quite easily.

Reverting to chemical expression, the reactions of softening are as follows:—

On heating hard waters:—

Bicarbonate of Lime=Carbonate of Lime+Carbonic Acid+Water.
(Soluble) (Insoluble) (Gas)

On adding lime to cold water:—

Bicarbonate of Lime+Lime=Carbonate of Lime+Water.
(Soluble) (Soluble) (Insoluble)

On adding Soda to permanently hard water:—

Lime Sulphate+Carbonate of Soda=Carbonate of Lime+Sulphate of Soda.
(Soluble) (Soluble) (Insoluble) (Soluble)

This shows the action of lime in removing temporary hardness.

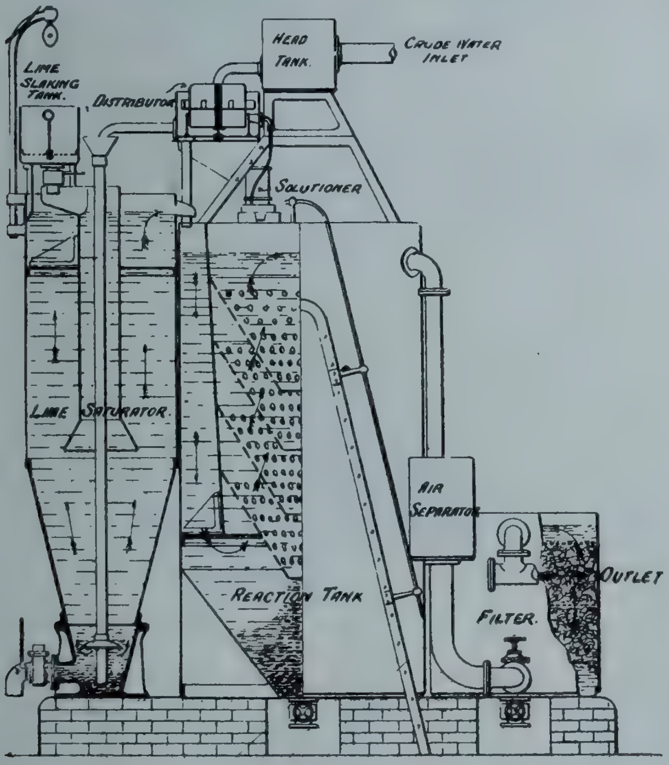


Fig. 4.

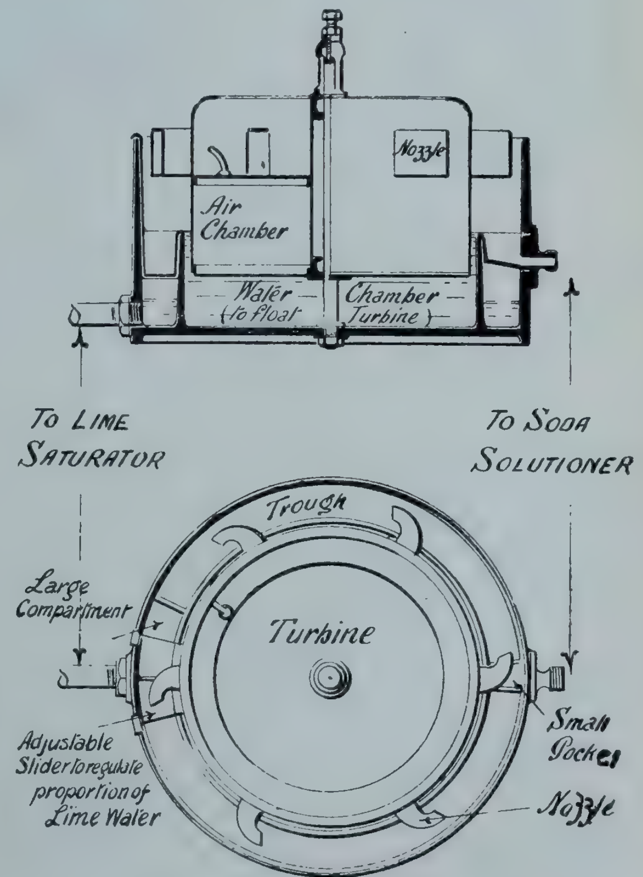


Fig. 5.

If magnesium salts are present an excess of lime has to be used, and then the action is as follows:—

(a) Mg. Bicarbonate+Lime=Mg. Carbonate+Carbonate of Lime+Water.
(Soluble) (Soluble) (Partly Soluble) (Insoluble)

(b) Mg. Carbonate+Lime+Water=Mg. Hydrate+Carbon. of Lime
(Partly Soluble) (Soluble) (Insoluble) (Insoluble)

The above reactions show very clearly the way in which the injurious salts are precipitated in the water softening apparatus as insoluble salts which can be moved by filtration.

The reader will now be in a position to understand and criticise some of the rival makers of softeners which are on the market, and fortunately we are able to give many interesting and not very widely known details and pictures of the products of several firms.

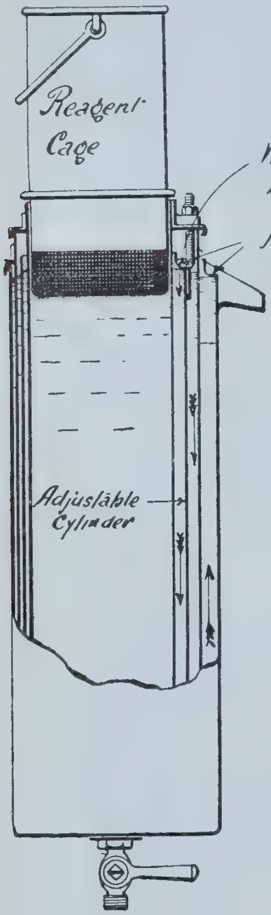


Fig. 6.

Types of Softeners.

One of the best known patterns of water softener in this country is probably that made by Lassen & Hjort. It is about eleven years since it was put upon the market, and over 2,300 plants have already been erected in all parts of the world. The plants are all manufactured in London.

Fig. 1 and Fig. 2 shows the rectangular and cylindrical types respectively. The latter pattern is often advantageous where ground space is limited, or where the discharge is to be at a higher level. It is worth while giving a full description of the actual process.

Fig. 1.—The water to be treated is led through the pipe K, into one of the chambers of the oscillating receivers. When this chamber is filled the centre of gravity is moved, and the receiver tips over, pouring its contents into the intermediate tank B below, at the same time bringing the other chamber of the receiver underneath the orifice of the pipe K. On the side of the oscillating receiver is fixed a semicircular tank D, containing the chemicals (lime and soda ash or caustic soda) and in the bottom of this tank a valve is fitted, through which the chemicals fall into the chamber B. To the receiver is fixed a system of levers which at every oscillation actuates the valve at the bottom of the tank D. The lift of the valve can be regulated by two small nuts fixed on the valve spindle, so that a given quantity of chemicals can, by this arrangement, be mixed with the water.

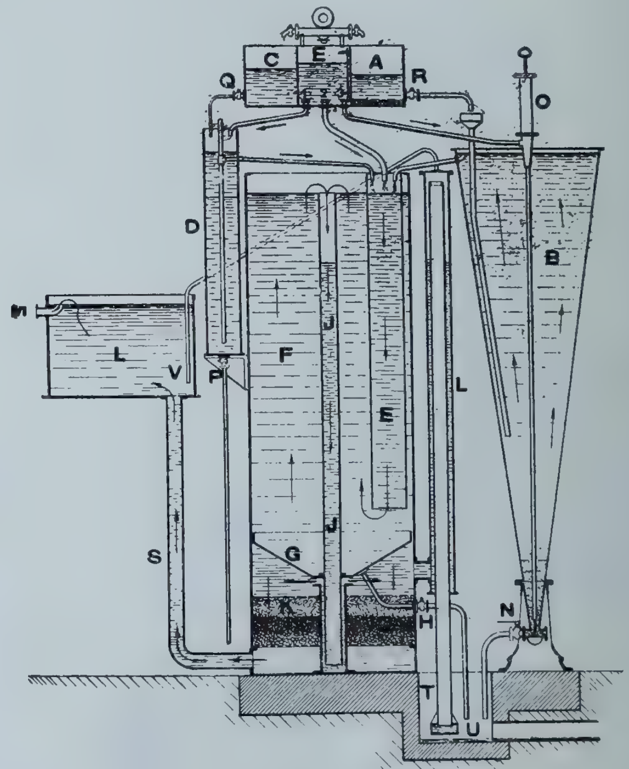


Fig. 7.

The lime milk in this apparatus has a strength of 10 per cent; the lime water used in other apparatus has only an average strength of 0.13 per cent; the lime milk, therefore, has a strength of nearly 100 times that of the lime water, making it possible to reduce the size of the tanks containing the lime, in the same proportion.

Fig. 2.—In order to keep the lime milk in constant motion, an agitator is fixed inside the semi-circular vessel containing the chemicals, and the oscillation of the receiver is utilised for driving the agitator.

The heating chamber B is provided with a steam nozzle for either live or exhaust steam. The water is generally heated to a temperature of about 150 degrees Fahr., to faciliate the precipitation of the foreign matters. However, where steam is not available, the water can, of course, be treated cold.

From the heating chamber the water passes into the settling tank A, where the precipitation takes place. Before leaving the tank the water has to pass through the filters, which are of wood wool, packed tightly between two rows of wooden bars. The filters can easily be taken out and cleaned by removing the top bars, and the filtering material can be used over and over again, after having been properly cleansed. Sludge cocks, F, are provided for drawing off the precipitate.

The softening and purified water coming from the filter flows into the storage tank O, at the end of the softener, and is drawn therefrom. The flow of water to the oscillating receiver is regulated by means of a high presure float valve, fixed on the pipe K.

It will be seen from the above that the apparatus is very simple and compact, and every part is easy of access.

In cases where ground space is limited, softeners can be made to suit local conditions.

It is sometimes found to be more advantageous to have a softener of the cylindrical type particularly where it is essential that the discharge of soft water should be at a high level; in this case the settling and filtering tank is made cylindrical, the automatic measuring apparatus for mixing the lime and soda, however, being the same as in the rectangular type. The water enters the oscillating receiver in the usual manner, and after having been mixed with the chemical reagents passes down to the bottom of the settling chamber and rises up through the tower after having precipitated the heavy foreign matters at the bottom of the tank. Before leaving the plant the water is filtered through a wood wool filter, and is then ready for use.

Fig. 3. gives a very good idea of a completed plant for 15,000 gallons per hour, the tanks being enclosed at the top of the tower.

There are no settling plates of baffles in this softener which is quite an advantage, as when present they are apt to become choked, and then retard the process. The chemical mixing tank shown in Fig. 2 is provided with a pump suitable for pumping a very heavy sludge of lime, which it delivers to the container of the measuring apparatus, any excess coming back to the mixing tank. It can be driven by power or hand, or by water motor, by the hard water entering the softener, and it can be adapted for use with the softener shown in fig. 1.

Simple tests can be made in a few minutes by the man in charge to ascertain whether the softener is working properly.

No article on water softeners would be complete without making mention of The Harris Anderson, another very well known softener. It is one of the softeners which favor the use of lime water rather than milk of lime, and it consists of a distributor, a lime saturator, a solutioner, a reaction tank and a filter.

Fig. 4 shows a diagrammatic section of the complete apparatus, while Fig. 5 shows the solutioner. If an internal filter is fitted the perforated settling plates in the reaction tank are removed.

There are two important patented devices to achieve; (a) The automatic separation, from the total flow of water, of predetermined fractional portions unaffected by the rate of flow; (b) The automatic conversion of these portions into reagent solutions of suitable strength to be returned to the water for softening.

Operation (a) is effected by the distributor (Fig. 4) which consists of a water borne turbine into which the hard water flows.

The first operation referred to is effected by means of this simple contrivance. The water leaves by bent nozzles, and thus the turbine is rotated about a vertical axis. The water from the rotating nozzles, falls into an annular trough, over which it is, of course, uniformly distributed.

In order, therefore, to divide off (say) one-tenth of the total water from the remainder, it is only necessary to divide the trough by radial partitions into two compartments, one of which is one-tenth the whole trough. The water received in this compartment will be, consequently one-tenth of the total flow, and is led off by a separate pipe. Moreover, the proportionality will hold good at all rates of flow.

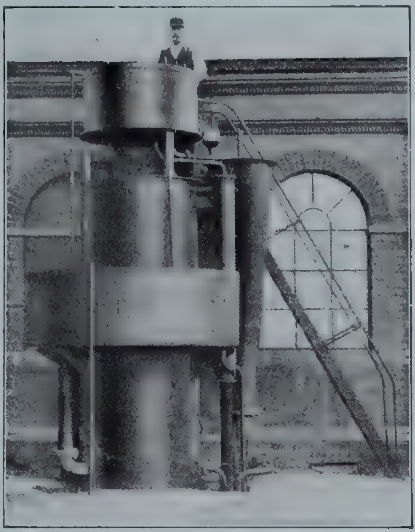


Fig. 8.

When using lime the correct proportion of the water, as decided by its composition, is divided off to be converted into saturated lime water. This proportion naturally, varies with different waters, but the commonest amount required is in the neighborhood of 10 per cent.

The compartment in the distributor in which the water to make lime water is received is made so as to give the exact proportion needed, readily altered to any other proportion if ever required. The water from this compartment is taken to the lime saturator.

When using soda ash, caustic soda, or any other soluble reagent, either with or without the lime treatment, much smaller compartments are employed (one-half, one or two per cent.) These take the form of small sharp-edged pockets of the proper size and shape, fixed radially in the annular trough, and the portions of water received in these are led by separate pipes to the "Anderson" solutioner, described hereafter.

The only moving part in the "Harris-Anderson" water softener is the distributor turbine. This floats in water, and is guided by roller bearings, so that it is subject to practically no friction, and will run for years without any attention but an occasional drop of oil in the guide.

The lime saturator consists of a tall tank with conical bottom, charged with slaked lime run in in the form of cream. The water from the proper compartment of the distribtuor is led to the bottom of the saturator by a funnel-topped central pipe, passes upward through the mass of lime, agitating it in passing, and dissolving as much as it will; it settles in the upper part of the tank, and issues by the spout as clear, strong lime water. The saturator is provided with certain special fittings which increase the efficiency of the saturation and settling. A sludge is provided for the removal of the waste lime before re-charging.

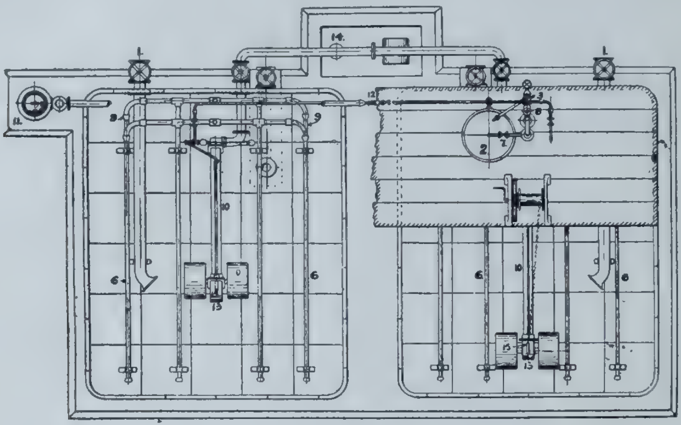
In some cases (especially in very small plants for domestic use) the quantity of water passing through the saturator is not sufficient to give good agitation. A special form of automatic air blower, worked by the fall of the remainder of the hard water which operates an intermittent syphon. By this means air is driven through the lime charges at frequent intervals, and stirs it up thoroughly.

To alter the dose of lime it is not practicable to vary the strength of the lime water, which is always used saturated. The proportion must be varied, which is readily and instantly done to a known and definite extent by shifting the movable wall in the distributor trough.

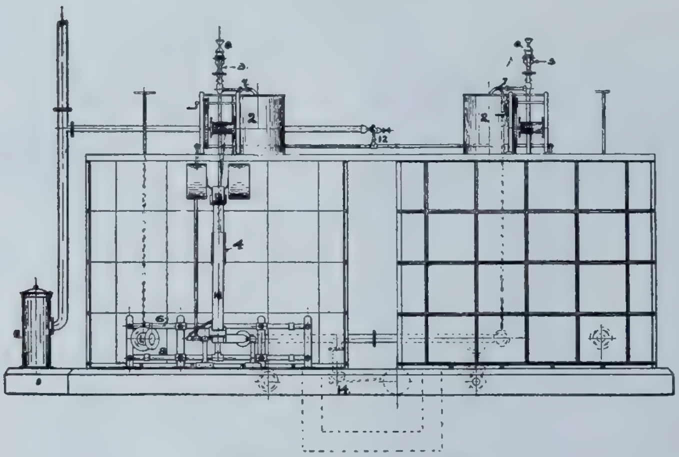
The solutioner (Fig. 5) performs the important duty of automatically converting the small fractional quantity of water from the distributor into solution of the soluble reagent of proper strength.

It is of extremely simple contsruction, consisting merely of an external cylindrical vessel contaning three other cylinders, open above and below, and nested into one another, thus forming an inner space inside the smallest cylinder, and three other spaces between the walls of successive cylinders as one proceeds outwards.

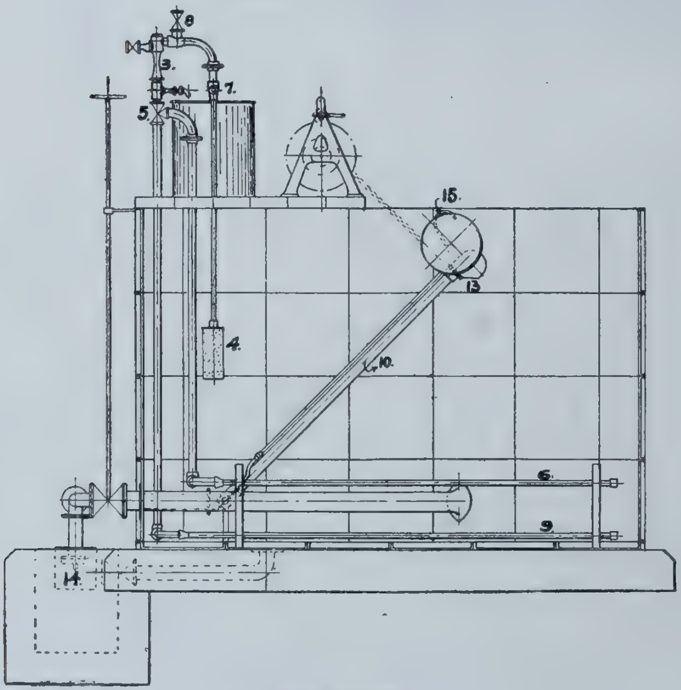
The outer containing clyinder has a notch cut on its upper edge leading into a delivery spout. The second cylinder is fixed in position, and carried some little way above the top of the third cylinder, which is adjustable vertically by a nut working on a screwed bolt secured to it, and is provided with a notch like the outer one.



PLAN.



ELEVATION. PART IN SECTION.



CROSS SECTION
Fig. 9.

The fourth cylinder is fixed in position, carried up above all the others, and is provided with a gauze-bottomed cage or receptacle, carried by a ring at such a height that its bottom is an inch or so below the level of the notch on the outer cylinder.

The easiest way to describe the action of this contrivance is to imagine it at first without reagent. Let the whole apparatus be filled with water, and the movable cylinder adjusted so that the bottom of its notch is slightly above that of the notch on the outer cylinder. Now insert the small pipe leading from the ditsributor pocket into the space between the smallest cylinder and the adjustable one. The water from this pipe will flow down the space, up by the outeromst space, and away over the outer notch, and the water level of the whole affair will be the level of the outflowing water; the cage therefore dipping in an inch or so.

Now while the water continues to flow, charge the cage with the reagent in any sufficient quantity.

The reagent in the cage now begins to dissolve, and heavy solution streams down the inner space to the bottom of the solutioner. Here the flowing water takes it up and mixes with it as it passes on, so that the liquid rising up the outer space to the notch is no longer water but solution.

As the outer space now contains solution, of density greater than that of water, to maintain the equilibrium the level of any column of water in connection with it must rise. Hence, as the overflowing solution becomes stronger the level of the water in the other spaces rises. The level rises then in the space into which the water is flowing, and it continues to rise until the solution becomes strong enough to bring the level of the water up to the notch on the adjustable cylinder.

When the water reaches this point it partly overflows, and the overflow water passing down the intermediate space mixes with the solution at the bottom of the outlet space and prevents it from getting any stronger. Thus at any setting, the strength of the outflowing solution automatically adjusts itself so as to be constant, as any tendency to increase or decrease in strength is immediately compensated by a slight rise or fall in the governing column, resulting in a slight increase or decrease in the water overflowing down the intermediate space.

It is clear that the strength of the solution delivered can be varied at will by raising or lowering the adjustable tube. If this be raised, stronger soluttion is obtained: if lowered, weaker solution.

Two other points may be mentioned, which are of importance. First, the strength of the solution delivered is within working limits independent of the rate of flow of water through the solutioner. Second, the strength of the solution delivered is independent of the temperature of the water. And finally, as soon as a certain amount of strong solution has formed in the inner space and bottom of the solutioner, the inner column, on account of its density, shortens and falls out of contact with the substance, so that on standing or working at low loads the substance does not continue to dissolve indefinitely. As soon as more strong solution is required the top of the column rises to the cage again automatically. It is a simple matter to adjust the apparatus to give any treatment desired, and the adjustment of the solutioner, once made, need not be altered unless the water varies in composition.

It is noteworthy that the operations involved in working this softener are very simple. They are as follows:—

This is done by slaking sufficient lime for the run (for which a special slaking arrangement is usually provided). The quantity for this need only be approximately known, and in each case is quickly decided by experience. A portion of the contents of the saturator being run off by the sludge cock, to carry away the waste lime from the last charge, the new charge mixed into a cream is run in, the saturator filled up, and the plant is again in operation.

For charging the solutioner, a quantity of the solid reagent is placed in the cage. It need not be weighed at all unless desired. In order to sludge the treatment vessel and filters, open the sludge valve and run off the accumulated deposit at intervals. This will also clean the filter if an internal one, and the filter may also be washed down occasionally with fresh water. External filters have independent sludges in addition. Any deposit in the solutioner should also be occasionally run out by the cock at the bottom.

The exact routine to be pursued depends on the particular plant in question, but generally speaking the working comprises a few minutes attention every twelve hours.

Reisert Water Softening Plant.

Another lime water and soda plant is the "Reisert" made by Royles Ltd., of Manchester. A section of this is shown in fig. 7, while figure 8, shows a completed plant at Rugby.

In this apparatus the carbonate of lime is precipitated by hydrate of lime (lime water) and the sulphate of lime by soda. The softened water is then filtered and discharged. The apparatus acts entirely automatically, all that is necessary is to supply the lime and soda daily and follow the very simple and clear directions supplied with each apparatus.

The apparatus consists essentially of an automatic lime saturator B, a soda chamber D, a water distributing tank E, with a lime slaking division A and soda mixing division C, a reaction chamber F, and an automatic self-cleaning filter K.

The lime saturator B cannot conceivably be more simple and reliable than it is. It requires no stirring contrivance, and lixiviates the lime completely, and owing to its upward widening shape it turns the saturated lime water into a clear fluid.

By a constantly uniform water supply through the micrometer valve 3 from the distributing tank E, which is conducted downawrds through the central pipe O, the lime paste at the bottom is stirred up and thoroughly impregnated, and rises, at first, partly with the water, until the rapidity of the rising water diminishes so much, owing to the upward widening shape of the saturator, that the undissolved lime particles are no longer able to follow so that the saturated lime water, clarified, then leaves the saturator B at the top, and is carried into the re-action chamber F by way of the mixing pipe E.

Hydrate of lime (slaked lime) possesses the property of dissolving, in a definite proportion in water, until the latter is saturated; the water does not absorb more, be the quantity of lime present ever so large. This property renders it possible to continually keep a uniform stream of water supplied (in a definite proportion) as required, with hydrate of lime for the precipitation of carbonate of lime. This uniform addition of hydrate of lime is so important that on it substantially depends the degree of purification of the water. Neither in the form of powder nor milk of lime can lime be added in a constantly uniform quantity.

The soda apparatus D acts in an equally simple and safe manner. Whereas lime dissolves only in a definite proportion, there is almost no limit to the solubility of soda. A quantity of soda that will suffice for one day is dissolved in the chamber C and let down into D through cock Q. The action of the soda apparatus is based on the fact of the soda solution having a greater specific gravity than water, and thus the water flowing from the distributing tank E through the small micrometer valve I—which is adjusted in accordance with the amount of soda required—into the soda chamber D, remains always on the surface of the soda solution (no mixing occurs) and displaces the same, it being carried through the small pipe from the bottom upwards, and into the mixing pipe E, and finally into the reaction chamber F.

E is the water distributing tank, and is supplied with the hard water to be treated by pipe and cock as shown; it is also provided with an over-flow pipe. It is further provided with three micrometer valves at an equal height, viz:—(1) for the supply to soda tank; (2) for the supply of untreated water to the reaction chamber, and (3) for the supply to the lime saturator B. By arranging these three valves at an equal height, the quantities of water flowing from them are always proportionate in the event of less water being supplied to the apparatus than corresponds to the capacity, or in the event of the water supply ceasing altogether they cease flowing simultaneously.

A lime-slaking division A is arranged in the distributing tank. In it, once a day, the required quantity of lime is slaked by means of a supply of water obtained from the water inlet pipe. The lime paste is then conveyed in bulk to the bottom of the lime saturator B through the short pipe by opening cock R.

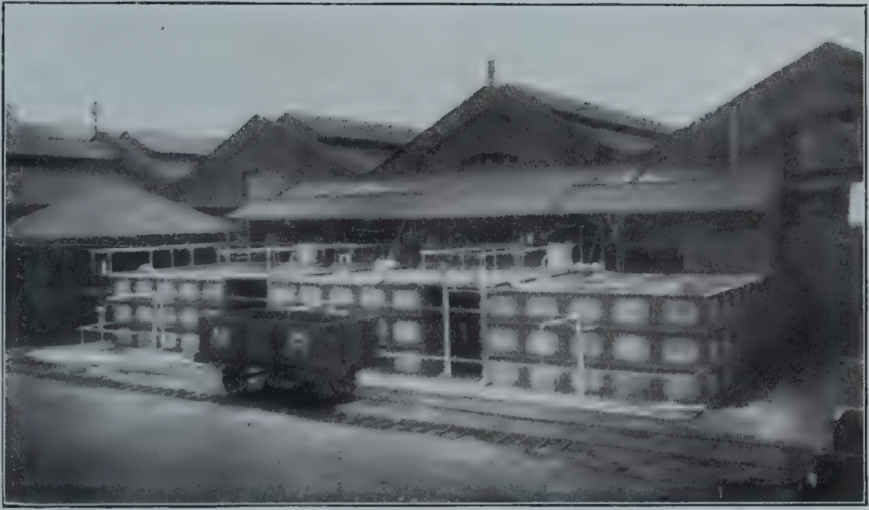


Fig. 10.

The reaction chamber F thus receives, through the mixing pipe E, the untreated water, lime water and soda water, and which remain in this chamber until the chemical reactions have been accomplished. The continuous inflow of the water and chemicals above described overflows via the pipe J into the filter chamber K following the course of the arrows downward through the filter bed and upwards through pipe S into the tank L, the rest flowing away at M to reserve or for use. It will be obvious that the height of the column of water in the pipe J will vary with the resistance of the filter bed, and as the latter fouls the water will rise higher and higher in J. Similarly it will rise to an equal and corresponding height in the syphon pipe L, and as soon as the resistance through the filter bed reaches such a point as to cause the water to overflow this pipe, it forms a syphon and instantly reverses the current through the filter bed, drawing backwards the clear water held in the small tank L, and thus thoroughly and automatically cleanses the filter, the sediment being discharged at T into the gully U. The small tank L is proportioned to hold sufficient water to thoroughly flush the filter K, and as soon as the tank is empty air enters via the pipe V and destroys the syphonic action. The filter then resumes its normal action and so continues until the fouling is again such as to cause the pipe L to overflow, when the cleansing action is repeated. How often this occurs depends of course, on the nature of the water being treated, but the important point to be noted is that the cleansing is automatic. It is performed as required and no oftener, neither is it possible to neglect it. The loss of water in reflush is very trivial.

Obviously the automatic cleansing puts it out of the power of any one to neglect it, neither is it possible to waste water by careless or too frequent cleansing. It quietly attends to its own work and does it thoroughly as often as required. The filtering material does not require renewing and never wears away.

Owing to the fact that the soluble salt sulphate of sodium, which is the result of the lime and soda process, causes foaming and priming in some boilers, Messrs. Royles have evolved the "Reisert" limes and barytes process. Carbonate of lime and sulphate of barytes are formed, and being insoluble in water are got rid of as sludge in the reaction tank. This process is specially to be recommended for locomotive and tubular boilers.

Deeley System.

A completely different plant is the Archbutt Deeley for which Mather & Platt are sole licensees. Figure 9 show a plan and sections of a two tank plant suitable for 600 to 10,000 gallons per hour. The plant comprises two cast iron tanks, fitted up exactly in the same way, the processes of filling, softening, and clarifying being carried on in one whilst softened and clarified water is being drawn off from other.

For 6,000 gallons per hour, and less, one softening tank is sufficient if a storage tank be provided. For more than 10,000 gallons per hour, three or more tanks are desirable. The hard water is admitted to either tank by means of the supply pipe (1) up to the level of a gauge mark on the side of the tank.

While the tank is filling, the quicklime and carbonate of soda are weighed out, and boiled up with water in the small chemical tank (2) by means of live steam.

Some waters require also the addition of a little aluminoferric. This is conveniently prepared in the form of a standard solution, of which a measured volume is added to each tank of water immediately after the chemicals have been run in.

When the tank is full up to the mark, and the inlet valve has been closed, steam is admitted to the blower (3) causing a current of water to circulate up through the rose (4) the three way tap (5) down the vertical pipe and back into the tank through the perforations in the upper row of horizontal pipes (6) The three-way tap (7) is then opened and the prepared chemical solution is slowly drawn into the circulating current, and thus diffused throughout the body of water in the tank.

The air tap (8) is next opened to admit air through the pipe at the top of the blower, and the air is blown for a few minutes into the treating tank, through the upper pipes (6); then by reversing the three-way tap (5) the air is forced through the perforations on the under side of the lower row of pipes. (9) From these it rises in streams of bubbles, stirring up some of the precipitate or mud from previous operations which lies on the bottom of the tank.

After the blower has been in operation for a few minutes (usually ten, but varying with different waters) the steam is turned off, and in about one hour very nearly all the precipitate will have settled to the bottom of the tank, and the water, even down to a depth of six feet from the surface, will not contain on an average more than about one grain per gallon of suspended matter.

The process of carbonating is very simple, and the extra labor and cost involved are inconsiderable. The operations of carbonating and drawing off are automatically and simultaneously effected by means of the hinged pipe (10) of rectangular section, the mouth of which is kept just below the surface of the water by means of floats. Fuel gas from the coke stove (11) is forced continuously, by means of the small steam blower (12), up the pipe, escaping by the discharge mouth (13) and being caught by the descending current of water (which in flowing down the pipe is repeatedly splashed upwards by baffles fixed at intervals along the bottom) is carried along with the water through the ball tap (14) fixed over the small supply tank, into which the softened and carbonated water falls, whilst the residual nitrogen, etc., of the fuel gas escapes into the air. If the small tank should fill up and cause the ball top to close, the gas escapes through the vent pipe (15). A gauge mark on the side of the softening tank, about two feet from the bottom, indicates the level below which the water is not drawn off. Shortly before the water reaches this level the further descent of the discharge pipe is stopped by a "rest" fixed on the bottom of the tank.

The quantity of carbonic acid required is only just enough to convert the slight excess of alkali used in softening into bicarbonate and it is controlled by a very simple test. No injurious effects need be apprehended from the presence of sulphur in the coke, for assuming the coke to contain 2 per cent. of sulphur, even if all this sulphur were to be oxidised to sulphuric acid, the quantity of sulphuric acid per gallon of water would amount to only 0.055 grain; and as the softened water of three degrees hardness contains fully fifty times as much alkali as is required to neutralise this amount of acid, the sulphur in the coke cannot possibly do any harm whatever.

Experience proves that for boilers, carbonating is not always necessary; and that where it is necessary, occasional carbonating is often sufficient to prevent any trouble from deposit in feed pipes.

The precipitate is prevented from unduly accumulating in the tank by its partial removal at regular intervals. This is effected in various ways to suit different circumstances. From the nature of the precipitate it is easily dealt with. In small plants, a discharge pipe is provided in one corner of the tank, and by lifting a plug daily, a sufficient quantity of mud can be run off. In larger plants the mud is swept out, at longer intervals, through mud doors, into a trough which conveys it onto waste ground; or it is raised out of the tank or trough by a steam lifter, and discharged into a cart lined with waste furnace ashes, through which the excess of water readily drains, leaving the nearly dry mud and ashes ready for tipping.

Plant of Midland Ry. Co.

Figure 10, gives an excellent idea of the Midland Railway Company's plant at Derby for treating 30,000 gallons per hour. The hardest water at present being treated is at the Moorland Sanitary Steam Laundry, Weston-super-Mare. It varies in hardness from 40 degrees to 80 degrees, and contains both carbonate and sulphate of lime, as well as a large quantity of magnesium salts. By this treatment the hardness of the water is reduced to an average of 5 degrees.

The process has been adopted for softening water in a great number of works, both at home and abroad, such as water works, woollen and worsted mills, paper mills, and laundries, in which the quantities of water treated range from 300 gallons to 100,000 gallons per hour. It has been found applicable to all kinds of hard water, and gives the best results when magnesium salts are present, the hydrate of magnesia forming a coarser precipitate which settles more rapidly than carbonate of lime.

Enough has been said in this review of the present position to show that water softening is not to be ranked either as a consulting engineer's fad, or as a costly refinement not worthy of a works manager's consideration. It is only by increasing the efficiency of our methods of production that we can hope to maintain our commercial spremacy in those industries in which we are still supreme. To those concerns which seem to be playing a losing game in competition with the foreigner we say "Wake up. Look to your methods and see that there is no waste going on in your boiler installations which might be avoided." It is well worth the while of every boiler user to go thoroughly into this question of water softening without delay, for delay means loss, while the adoption of modern scientific methods may easily turn a loss into a profit.

EFFECT OF FEED-WATER REGULATORS ON SUPERHEATING.

By W. E. Crane.

ONE important item in the operation of steam boilers is that the circulation shall be continuous, as the more rapid the water flows over the heating surfaces the more rapid will be the absorption of heat. To attain this the feed should be as hot as possible, and it should be fed in constant quantity and the water level maintained at one point. If the feed is continuous, the heater will be doing its best work, as it is not overloaded part of the time.

If the circulation is continuous, the deposit from the water is carried to the rear and the result is a clean boiler; whereas with the feed turned on strong at times, the circulation is checked and deposits are spread all over the heating surfaces to be burned on.

A steady feed means freedom from strains, either from unequal expansion or unequal loading. A uniform water level, not too high, means a uniform quality of the driest steam the boiler is capable of making.

The above would indicate that automatic feed regulators were the proper thing.

The objection is made that an automatic device cannot be as reliable as human watchfulness; but we have safety valves, engine governors, traps, damper regulators, pump-pressure regulators, ball floats, etc., all of which are more reliable than trusting to human care. The public is learning that where human life is at stake the human element must be removed as much as possible. On railroads the sending back of a flagman did not prevent rear-end collisions, and the block-signal system was established only to prove that there was the human element that was unreliable still. And the automatic signals have been put in by the leading roads, but the human element still remained on the engine, as was proved by the man who ran his train past three automatic signals and two held by hand. When the New York subway was built, automatic signals were put in, and should a man attempt to run by, an automatic device shuts off his current; so it is too late in the march of progress to talk against automatics. It is simply a question of getting the best and most reliable, and as much as possible, something that cannot be monkeyed with.

Hand Feed Regulation.					Automatic Feed Regulation.				
Time P. M.	Steam Pressure.	Temperature of Steam in Pipe.	Temperature Due to Pressure.	Superheat.	Time P. M.	Steam Pressure.	Temperature of Steam in Pipe.	Temperature Due to Pressure	Superheat.
1	147	389	364	25	1	138	382	359	23
2	145	370	363	7	2	137	380	358	22
3	143	389	362	27	3	130	376	355	21
4	145	402	363	39	4	140	388	361	27
5	145	402	363	39	5	142	390	362	28
6	145	376	363	13	6	140	387	361	26
7	147	377	364	13	7	140	393	361	33
8	147	383	364	19	8	135	391	358	33

I recently had some regulators attached to a set of water-tube boilers with superheaters. These boilers were not driven hard, so that the superheat was not high; but the result of the regulators is not uninteresting.

The thermometer was placed in the steam pipe in the engine room an average of 150 feet from the boiler outlet. There was no chance to put in a thermometer at the boilers. The temperature was taken from the steam pipe before the regulators were applied, and also after they had been in use for some months. During the latter time the flue and damper had become warped and worked hard, so that the steam was not kept as regular, and also the firemen were not as good.

The first column is the time, the second the steam pressure by gauge, the third the temperature of steam in the steam pipe, the fourth the temperature due to the pressure, and the fifth the degrees in superheat.

When the superheat showed but 7 degrees it was found that the water in the boilers was nearly to the top of the glass gauges.

Afterward a man was put on for two hours to keep the water at the lower gauge cock, which is about 4 inches below the middle of the drum. The result is shown in the superheat at 4 and 5 o'clock. The log with the automatic feed regulation speaks for itself. At about, or a little after, 6 o'clock an extra engine is cut in, the fires are a little hotter and it should show in the superheat. It does not show in the hand regulation, but does with the automatic feed.

The interesting thing about the table is the effect on the quality of the steam when the feed is continuous and level of the water constant.

Steam cannot be superheated until the steam is dry, and the table indicates the quality of the steam entering the superheaters. It affects the quality of the steam that goes to the engines, even where there are no superheaters, and continuous feed and level water will give more economical results with any boiler, and when the relieving of the boiler from strains is taken into account, a reliable boiler feed regulator becomes an appliance that none can afford to be without.—Power.

A novel application of wireless telegraphy in the field of enginering is the installation which the Pennsylvania Railway has made for testing the usefulness of air messages for railroad operation. The mast used in the tests is located on the mountain near Altoona, at an elevation of 1,655 feet above sea level. Communication has already been opened with the stations on the Atlantic coast, and also with ships at sea.

The decrease in the drawbar pull of a locomotive as the speed increases, is more rapid than is generally understood. It is estimated that a 2,000 horse power compound locomotive of the Mallet type will exert a tractive force when it is hauling a train at a speed of five miles per hour of 150,000 pounds. At ten miles the tractive force will have fallen to 75,000 pounds; at 30 miles it will be 25,000 pounds, and at 50 miles per hour, it will be as low as 15,000 pounds.

The Sizes of Injectors for Feeding Water to Boilers

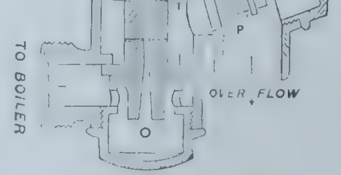
By Frank O'Leary

It is Often Necessary for an Engineer to Decide What Size of Injector he Should Install to Supply Water to a Boiler of a Certain Capacity. There are Several Things to Influence His Calculations. These are Given in the Accompanying Articles, and Also the Methods to Follow in Rapidly Calculating the Exact Size of Injector. A Table is Here Given, Compiled From Well-founded and Proven Experience, by Which Injectors May be Easily Selected.

THE proper size of a perfectly made injector required to deliver a given quantity of water to a boiler within a certain time, is determined by the location of the water relative to that of the injector—by the temperature of the water and by the steam pressure with which the injector is operated. A well-made injector is capable of holding its maximum capacity throughout a considerable range of steam pressures, and in its operation, of adding to the delivered water, the necessary amount of heat to meet the demand of safety in feeding water to a boiler, but to illustrate the question, we will presume to operate the injector from a boiler carrying 100 lbs. gage pressure, when the injector is lifting water of 74 degrees Fahrenheit from a depth of 5 feet. We wish to know what size an injector should be, when working under these conditions to supply the boiler with 600 gallons of water in one hour's time, and which would increase the temperature of the water from 74 degrees to a degree safe for the boiler to receive it. To do this, would require that the injector have one in. pipe connections, and that the steam tube of the injector be of the right proportion with an inlet that would admit a volume of steam that would, when condensed, equal one pound for every 14.25 pounds of water taken from the supply. It is interesting to know that the water flowing through the delivery tube of a well designed injector, doing this work under such conditions, is traveling with a velocity of 89 feet per second, and that the steam is entering the steam tube about 765 feet per second.

Selecting the Injector.

Departing from the exact nature of the question, "What is the necessary size of an injector that will put a certain quantity of water into a boiler in a given time, when working under certain conditions?"—we wish to explain that Penberthy Injectors, shown in the illustration, made for general sale, perform the work described, but IT IS NOT GOOD ENGINEERING TO SELECT AN INJECTOR OF A SIZE JUST SUFFICIENT FOR WHATEVER A BOILER'S REQUIRED CAPACITY IS. THE SIZE SELECTED SHOULD BE OF A CAPACITY 30 PER CENT. IN EXCESS OF THE BOILER'S REQUIREMENTS, when the injector is operated under the average condtions of lifting 3 to 8 feet, so if it should ever be necessary to furnish more water than usual, or, if the lift should ever be greater, the injector would still be equal to the demand made upon it. To explain why this is necessary, we will revert to the question, and instead of having the injector located so as to lift 5 feet, we will locate it to lift 10 feet, and still use 1 in. suction pipe. We shall find at the end of an hour's operation, that instead of taking 600 gallons from the supply, we have taken but 495 gallons, hence, it will be seen that a boiler requiring 600 gallons of water per hour could not be supplied with this injector when a 1 in. suction pipe was used, if lifting from a depth of 10 feet, but could be supplied by it when lifting from a depth of 5 feet. The volume of water supplied on the lift of 5 feet in condensing the steam creates a powerful vacuum, and permits the acceleration of the travel of water up through the suction pipe into the injector. When the lift is 10 feet, the vacuum in the injector may be as great, but the 10 foot column of water is of greater weight than the 5 foot column, and on this account, its speed upward through the suction pipe is not of such velocity, consequently the lesser volume on the 10 foot lift.



Section Penberthy Injector.

If we should take off the 1 in. suction pipe and replace with 1¼ in. pipe, the injector would maintain the same travel of water through it in feet per second, and on account of the greater area of the pipe, the capacity would increase from 495 gallons to nearly that of the 1" pipe on the 5 foot lift. Were we to increase the lift from 10 feet to 15 feet, and still use the 1¼ in. pipe, the injector would have about the same capacity as it had when working from the 10 foot lift using the 1 in. suction pipe. Should we change the temperature of the supply from 74 degrees to 120 degrees, the capacity of the same injector, operated with 100 lbs. pressure, lifting the supply from 5 feet below, through a 1 in. pipe, would change from 600 gallons (the capacity it had when the temperature was 74 degrees) to about 490 gallons per hour. This difference happens because the temperature of the supply affects the rapidity of the condensation of the steam operating the injector. This affectation is explained when we consider that the colder the water is, the greater its condensing power, and the slower the condensation is, the less power the vacuum produced. Consequently the same quantity of water will not rise in the same time through a pipe into a low partial vacuum as will rise into a higher partial vacuum.

Injector Under 100 lbs. Pressure.

We will now consider the capacity of the same injector operated with 100 lbs. pressure when the injector is connected so as to receive its supply from overhead tanks, or from city mains, in which cases, the injector does not have to lift, but is working with its supply flowing into it. Working under such conditions, the injector would have a capacity of about 700 gallons per hour, and, while the temperature of the water delivered would not be as high as when the injector was lifting 5 feet, it would still be within the limit of safety. There is considerable information being offered the engineer by manufacturers, who not altogether from an advertising standpoint, but from an educational one, publish attractive literature, and who, by talking to engineers, competently illustrate an article of their manufacture. In consequence of this, the engineer is a student of all the devices he uses, and when he requires a new article, he studies its adaptability to the conditions under which he is going to use it. An engineer of this sort in need of an injector, would consider that the greater quantity of injectors are made to lift from below their positions, and if he wished to use an injector taking water supply from overhead or from city mains, he would state that requirement when ordering the injector. By doing this, it would in many cases, be possible for him to get an injector one size smaller than that required if the injector was to be used lifting, because injectors of the same pipe sizes have considerably larger capacities when the water is flowing to them than when they are lifting. Besides, did the manufacturer know an injector was going to be used taking water from overhead or from city mains, he could proportion the steam tube of the injector to the requirement. If this change of proportion was applied to the steam jet of the injector, which we are considering when we were illustrating it as taking water from overhead tanks or from mains, we could state the capacity as being 800 gallons instead of 700, and also state that the temperature added to the supply greatly exceeded that delivered when the regular lifting tube was used. The steam boiler injector is a device of French invention, therefore, its dimensions were originally given from the metric system of measurement. The number of millimeters constituting the diameter of the bore connecting the combining and delivering tubes indicating the size of injectors for certain maximum capacities. But this method of describing the sizes of injectors, has, without authorship, been changed to a method more intelligible to people who are accustomed to the English scale, the popular method being to describe the sizes by using the letters of the Alphabet. In order to furnish boilers of different sizes with injectors not too large nor too small, injectors are made in two sizes for each iron pipe size from ¼ in. to 2½ in., inclusive. The table following, has been well founded and proven from experience, and can be used as true for the selection of the injector of proper size for any size boiler:—

Size	Horse Power Based on Ordinary Tub. Boiler	Horse Power Based on 30 lbs. Water per H. P. per Hour	Pipe Connection	Capacity per Hour, 1 to 3 feet lift, 60 to 85 lbs. Steam Pressure	
				Maximum	Minimum
				Gall.	Gall.
O	3 to 6	4 to 8	¼ inch	60	40
OO	4 " 8	6 " 12	⅜ "	80	55
A	8 " 16	10 " 20	½ "	135	70
AA	12 " 22	15 " 30	½ "	180	100
B	17 " 32	22 " 45	¾ "	280	140
BB	20 " 45	25 " 60	¾ "	355	170
C	40 " 65	45 " 80	1 "	475	300
CC	45 " 80	50 " 100	1 "	600	350
D	50 " 100	60 " 135	1¼ "	800	425
DD	75 " 135	85 " 165	1¼ "	1,000	525
E	100 " 180	125 " 235	1½ "	1,400	800
EE	115 " 255	150 " 320	1½ "	1,900	900
F	160 " 320	200 " 400	2 "	2,400	1,300
FF	200 " 400	250 " 500	2 "	3,000	1,600
G	300 " 500	325 " 600	2½ "	3,600	2,000
GG	375 " 600	400 " 750	2½ "	4,200	2,500

A Simple Water Softening Plant of Large Capacity

Sometimes a Concrete Example of What Others are Doing Will Help an Engineer in Undertaking a Certain Plan in Connection With Certain Work at his Power Plant. Water Softening Plants in Locomotive and Stationary Engineering Practice are Becoming More Common in Canada, and Engineers Generally Should Have an Intimate Knowledge of Them.

THE Penman Co., Paris, have in their works a water-softening plant capable of treating 144,000 gallons per 24 hours, removing practically all traces of impurities.

The plant, which uses the Archbutt-Deeley process, was made and installed by Mather and Platt, Salford Iron Works, Manchester, England, another one of the same type, but of smaller capacity being in use in Canada, at the Beardmore tannery, Acton. The only difference between the Penman plant and the typical installation of the same make, is in the tanks, which are of wood, circular in form, whereas the usual tanks used are rectangular, built-up for cast iron plates.

The water to be treated at the Penman plant is taken from the Grand river, and therefore varies considerably in its impurities at different seasons of the year, after storms, etc., but these impurities have been found to be principally sulphate of lime, carbonate of lime, sulphuric acid, and magnesia, the former two of these being very prominent. On the average the impurities run about 30 grains per gallon, varying as before mentioned, under different conditions of season, etc.

Water is said to be hard at times, because of its soap destroying proclivities, owing to the presence of compounds of lime and magnesia—chiefly the carbonates and sulphates. Hardness is generally distinguished as "temporary" and "permanent." Temporary hardness is caused by the presence in the water of the carbonates of lime and magnesia, these compounds being dissolved by water containing carbonic acid in solution, so that, if the carbonic acid be removed by boiling or by precipitation with lime, the temporary hardness disappears—almost entirely in the case of carbonate of lime, and to some extent in the case of carbonate of magnesia. As the latter does not occur in any appreciable degree in the Penman water, no further precautions for its removal need be followed.

The presence of sulphate of lime, constituting "permanent" hardness, is due to its solubility even in pure water, and is not dependent on carbonic acid. Therefore, the mere addition of lime will not affect its precipitation, but it must be decomposed by the action of some other compound such as carbonate soda.

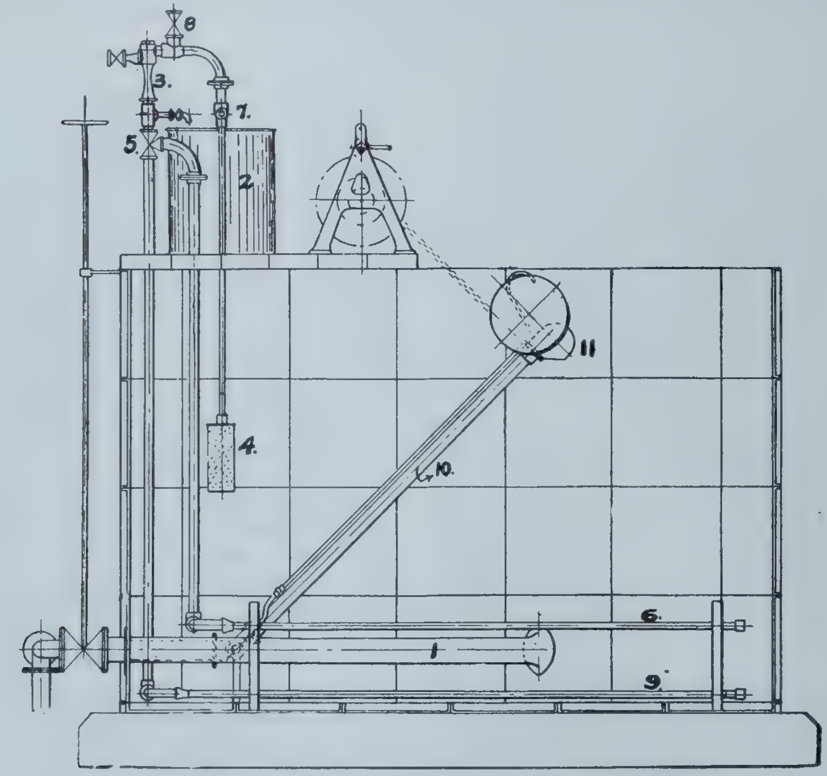
Simple tests are made to determine the extent of both the temporary and permanent hardness. For the former, the following method is in use at the Penman plant. A 50 cubic centimetre beaker, filled with the water to be treated, has methyl-orange added to it until the solution becomes yellow. Then deci-normal (half strength) sulphuric acid is introduced, until the resulting solution becomes orange in color. The number of cubic centimetres of deci-normal sulphuric acid multiplied by five gives the number of degrees of temporary hardness. For every degree of hardness, .9 pounds of fresh burned slaked lime are required per 10,000 gallons. This lime must be as free as possible of magnesia and is obtained in crystalline form specially from Pennsylvania. To check the correctness of the test, after settling add a 5 per cent. solution of nitrate of silver to a beaker full, and if the solution becomes yellow, the amount of lime is correct, whereas a brown tinge indicates too much lime.

The permanent hardness is ascertained by the soap test. The soap mixture consists of 10 grammes of castile soap, 600 cubic centimetres of alcohol, and 400 cubic centimetres of distilled water (1 litre of liquid). A test of the soap solution itself is first applied. If of the proper strength, one gramme of the soap solution will produce a lather in 10 cubic centimetres of a solution composed of 1 gramme of calcium chloride to a litre of distilled water. The number of cubic centimetres of this corrected soap solution required per 50 cubic centimetres of the water under treatment, gives the number of degrees of hardness. For every degree of hardness, one half pound of soda ash (58 per cent. bicarbonate of soda) per gallon, is required.

Description.

The plant consists essentially of two circular wooden tanks, identical in danger, and each capable of holding 14,000 gallons, with a 60 gallon solution mixing tank for each, as well as the injecting system, the whole of which, for one tank, is shown in accompanying sketch. The plant is made double in this way in order that the processes of filling, softening, and clarifying may be carried on in the one, while softened and clarified water may be withdrawn from the other, and vice versa, the two sets of operations being concurrent.

Referring to the diagram, water is fed into the tank from a centrifugal pump through pipe 1, filling the tank to the desired level, the quantity of water being known. Simultaneously with this operation, the predetermined quantity of chemicals are placed in the mixing tank 2, and thoroughly dissolved by a steam jet stirring them thoroughly in the water. When the tank is filled and the chemicals dissolved, live steam is admitted to the blower 3, which causes water to circulate up through the rose 4, down through the three way valve 5, and out into the tank again through perforations in the upper set of pipes 6, of which there are several, spaced about 2 feet apart. The three way tap 7 is then opened which draws the chemical solution in with the circulating water, and thoroughly intermingles it with the water in tank. After completely injecting this chemical, the air valve 8 is opened, drawing in air, blowing it through the upper pipes 6 for a few minutes. The three way cock 5 is next turned to direct the circulation through lower pipes 9, instead of upper pipes 6. These pipes 9 have their perforations on the lower side, so that, being very close to the bottom the sediment is churned up into the water ; and this sediment, when the blow is turned off, being heavy, has a tendency to quickly settle the suspended fine matter in the water, leaving the water quite pure in a very short time, and containing less than a grain of suspended matter per gallon.



Cross Section Softening Plant, Penman Co., Paris.

Drawing off is accomplished by the hinged pipe 10, the mouth of which, 11, is kept just under the surface by floats. This insures the clearest water being drawn off at all times.

As each of the tanks holds 14,000 gallons, and the capacity of the plant is 6,000 gallons per hour, upwards of 2½ hours are allowed for the softening and settling operation, before any drawing off need be done, the latter lasting another 2½ hours.

The softened water gives excellent results for the purpose intended which is the scouring of woollens in the dye-mill. Very soft water is especially necessary for black goods, and in fact for all materials for a great saving in soap is obtained. The water, while used to some extent in the boilers, has not proved very satisfactory there, due to its leaving a soft deposit on the flues. This soft deposit, however, is not like scale, for it can be easily flushed from the boiler. However, in justification to the plant, this deposit might be eliminated by the use of the carbonating system generally in use in the Archbutt-Deeley process, and which is supplied with the plant.

AMERICAN BOILER MANUFACTURERS' ASSOCIATION.

At the twenty-second annual convention of the American Boiler Manufacturers' Association, Chicago, a number of important questions were discussed, among them being boiler tubes, referred to in the editorial columns, boiler explosions. Referring to the rupture of tubes, Colonel Meier told of a case in his experience where rupture of tubes had grown to be a chronic source of complaint at one plant. He sent a man in quietly to see what he could learn as to the cause, and it was found that the engineer desiring to cool down quickly had been in the habit of throwing open the fire doors and suddenly cooling the tubes, hence the trouble. The tubes ruptured square off outside of the sheet. In another case the tubes had become choked with carbon deposits due to the use of an objectionable compound composed of a poor grade of oil and sorghum molasses; when the use of this was discounted the trouble abated at once. The boiler manufacturers must ask the insurance men to protect them by helping to stop such bad practices.

John J. Main, vice-president of the Polson Iron Works, Toronto, instances cases of explosions, some of which were due to faulty material, where the steel by analysis showed too high sulphur, and some were due to both faulty material and workmanship, the boiler not being a true round and permitting constant moving away from and returning to the circular form because of a long sheet underneath and two sheets overhead. The larger number of cases he had been called upon by the Government to investigate and report upon were caused absolutely by faulty operation, mostly in the case of locomotive boilers, due to low water. The speaker thought that there are too many poor boilers made, and this demonstrates the necessity for a uniform specification to have the backing of law throughout the Dominion of Canada.

Boilers may be, and in fact have been, hydraulically tested for pressure without the use of a pump. The cold boiler must be filled completely with cold water, leaving no air anywhere. Then build a small fire under the boiler, not to generate steam, but just to warm the water. Its expansion will immediately begin to cause pressure, which will show at the pressure gauge. When the test pressure is reached open a try cock and if everything is all right the water may be discharged at the blow-off until it is at the proper level for raising steam.

BOILER FEED PUMPS

By J. O. B. Latour*

In Connection With Boiler Feed, a Knowledge of Pumps is Very Important. In Making Instalations it is Necessary for Engineers to be Familiar With the Results Obtainable From Different Types of Pumps, in Order to Select the Most Efficient. In This Article Recommendations are Made Which Should be Perused Carefully by Every Reader, Full Economy Calculations are Dealt With and the Whole Subject Intelligently Presented.

THIS important part of a power plant is very often treated carelessly in its selection, installation and maintenance, leading to numerous troubles and expense. Before deciding on the apparatus the points to be considered are first cost, reliability and economy for the type of plant. A plant having one or two engines only are well adapted for a power-driven pump. In stationary practice a power pump is generally driven by a belt from some convenient shaft. In marine engines they are always driven by direct connection to the engine, very often without having any working joints. The stationary engine is just as well adapted as the marine type for this purpose but it is rarely found. A single acting plunger pump worked from the main cross head is without a question the most reliable, cheapest and most economical in fuel and repairs. The noise of the valves is often objected to but there is no reason not to use rubber ones which completely eliminates this trouble. I have used them successfully on marine engines of high rotative speeds for several years.

Fuel Economy.

The fuel economy can readily be calculated. Taking a fair valve engine non-condensing, of 100 I.H.P., at 100 lbs. boiler pressure and 90 revolutions per minute, this being a very common size outfit in stationary practice. A single plunger pump of 10 inch stroke would require a plunger 2 5-16 inches dia. if attached to work from the engine crosshead. The I.H.P. required to drive this pump will be about 2.3. If the avaporation of the boiler is 8.5 lbs. per lb. of coal it will require 82 lbs. of coal for 10 hours. A direct driven steam pump will require at least four times as much steam per I.H.P., therefore the coal for 10 hours will be 82×4=328 lbs., besides about 20 per cent. as much cylinder oil as the main engine. The regulation of the actual delivery can be done by a valve in the suction controlling the quantity, or by a loop connecting the suction and delivery pipes close to the cylinder to allow the excess water to be returned to the suction or by allowing the excess to be returned to the hot well. The latter method can only be resorted to when the water flows by gravity to the pump if its temperature is above 140 to 150 degrees F.

Condensing Engine.

If the same engine is to be run condensing the conditions are very much changed. The non-condensing type has an excess of exhaust steam to heat the feed water to 210 degrees F from any temperature with a suitable heater. The condensing engine will supply water at the hot well at a temperature of 110 degrees F when operating at a vacuum of 25 inches. Unless waste steam from some auxiliaries can be used to heat the feed water, then the temperature of the hot well will be the temperature of the feed water. The difference in fuel economy between water at 110 degrees F and 210 degrees F is 9.03 per cent. If the air and boiler pumps are driven direct by the engine we have to submit to this loss. The net gain by the condensing engine will be that due to condensing minus loss due to difference of temperature in feed water. The engine under example is to develop its capacity load with a M.E.P. of 45 lbs. If the condenser supplies 9 lbs. M.E.P. net the economy due to vacuum is 20 per cent. less power required to drive the pump which will reduce this to 19.2 per cent. Then 19.2 per cent.—9.03 per cent.=10.17 per cent. net gain for condenser with connected air and boiler pump.

Steam Driven Air Pump.

A steam driven air pump will develop about 4 I.H.P. to maintain 25 inch vacuum for this engine at a cost of 400 lbs steam per hour. The steam driven boiler feed pump will develop 3 I.H.P. at a cost of 336 lbs. steam per hour. To heat the required feed water of 3,760 lbs hour for 110 degrees F to 210 degrees F will require 351 lbs steam per hour at atmospheric pressure and temperature. Then we have total feed water increased from 3,000 lbs. to 3,760 lbs. by using steam driven pumps. Crediting the 351 lbs. returned as heat in the feed water we have 3,409 lbs. as net feed water or 13.6 per cent. more than with connected pumps. Deducting the 9.03 per cent. heat required to raise the temperature of the feed water from 110 degrees to 210 degrees remains 4.57 per cent. increase in fuel to be charged to steam driven auxiliaries. The quantity of steam per i.h.p. for auxiliaries may appear large at first sight. However, readers that have conducted tests on these steam consumers know that the results show from 80 lbs. to 160 lbs. per i.h.p. In an important and elaborate test I conducted about fourteen months ago, the quantity of gross steam used by steam-driven auxiliaries was over 18 per cent. These were not in an ideal condition, but they were far above the average.

Triplex Belt-driven Pump.

In a plant having many units pumps connected direct to each engine would be a mechanical inconvenience. In such a case a suitable triplex belt-driven pump has much to commend it. When a steam-driven type is the most convenient the outside packed plunger duplex long-stroke type will be found the most reliable.

Provide Injector.

During the hours that the plant is closed and where there are no means of heating the feed water, a suitable injector should be used. This instrument should always be provided for when the feed pump is driven by the main engine.

In many localities the feed water contains so many scale-forming salts that it becomes an absolute necessity to heat the water to high temperatures and filtering in order to reduce the scale-forming solids to the least quantity. Then heaters of the open and filtering type become imperative, and if the engine is condensing, steam-driven pumps are to be selected.

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Corrosion and Incrustations

By Jno. A. Bradley

WATER in a natural state contains many impurities, and is not the simple compound many of us have learned in chemistry, the union of hydrogen and oxygen, 2 parts to 1. Sometimes it contains free metric and sulphuric acids. Nearly all lake waters contain limestone, while river waters, as a rule, contain much organic and vegetable matters, spring and artesian waters contain soda as well as other foreign matters.

The weight of impurities in water varies greatly, but in moderately good water it is from twenty to fifty grains per gallon. What this amounts to in less than three months may be seen from the following. From the analysis made of water that is used in the central part of the country, it was found that the total solids amounted to 32,611 grains per gallon or .4.75 lbs. per one thousand gallons (one grain is equal to one seven thousandths of a pound). Hence a boiler evaporating about six hundred gallons of the above water per hour (about 160 h.p.) would collect a deposit calculated as follows :

$$\frac{600\text{ gals. X }4.75\text{ lbs.}}{1{,}000\text{ gals.}}\text{ equals }2.85\text{ lbs.}$$

This is the approximate amount of impurities collected in one hour. Part of this would form sludge and the remainder would be converted into hard scale.

If this boiler were worked a week of sixty hours, there would collect 60X2.85 equal to 171 lbs. of solid matter. In three months this would amount to more than one ton.

It must be remembered that while these solids are part of the original water, and cannot be detected by the eye, yet they are always left behind by the steam, and as shown above rapidly accumulate unless some means are taken to get rid of them. This point will be apparent to anyone who will take a glass of ordinary clear water and place a teaspoonful of salt in it. After stirring the salt for a few minutes it will entirely disappear and the water will be as clear as before, thus it is that nearly all solids are contained in feed water.

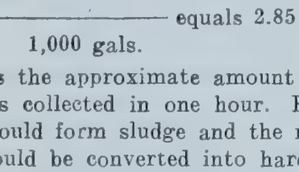


Fig. 1.

Evil Effects of Impure Water.

The evil effects of impure water may be divided under three heads (1) loss of power, (2) loss of fuel, and (3) danger.

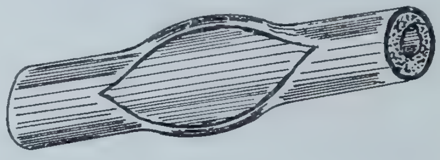


Fig. 2.

These conditions about to be described would exist in ordinary steam plants if no means were taken to prevent them. Fortunately, however, these causes and effects are fairly well understood and the proper treatment is applied.

Scale which is composed of lime, chalk and iron and is as hard as rock, forms on the submerged or water covered surfaces of the boiler. Both scale and sediment are poor conductors of heat compared with iron, and its presence on the heating surface of a boiler materially increases the fuel consumption and decreases the evaporative power. This loss varies considerably, because it depends on the composition of the scale. Some scales resist heat one hundred times as much as boiler plate of the same thickness. A layer of scale $\frac{1}{4}$-inch thick will often cause a loss of 35 p.c. of fuel, while an accumulation of $\frac{1}{2}$-inch may cause a loss of 60 p.c. It has been estimated that a boiler after working four to six weeks would evaporate from 8 to 16 p.c. less water per lb. of coal than when in a clean condition.

We sometimes hear the statement that a little scale is good for the boiler. This is true when the feed water is of a corrosive nature. The effects of corrosion is more insidious and injurious than scale, and it is consequently advantageous to permit the formation of scale of the thickness of an egg shell, as a preventive against corrosion.

To the presence of scale may be attributed burnt furnace crowns, caused by loss of heat and consequent overheating, bulged furnace crowns (see Fig. 1) and explosions by reason of the scale covering up dangerous corroded pieces of plate or rivet heads. In some instances the back headers of water tube boilers are filled with scale and circulation retarded, the tubes become overheated and rupture (see Fig. 2.)

Corrosion.

By corrosion is meant the chemical action of impure water eating or wasting away the plates. Gases absorbed by water are very active in the corrosion of boiler plates as are greases and other organic matter. Great care should be taken to prevent feed pumps from drawing air, because air is heavier than steam and if much is present it collects in bubbles and forms a layer between the water and the steam and rapidly corrodes the plate in the vicinity of the water line.

Probably the most destructive of the various actions which tend to shorten the life of the steam boiler is corrosion, and may be classified as internal and external. Internal may be present as uniform wasting, pitting or grooving. Examples of internal corrosion are shown in Figs. 3 and 4. There is no sharp division line between sound boiler plate and the wasted part, and the only way to determine is to drill a hole and measure the thickness of the suspected part. In the case of uniform corrosion large areas are attacked and eaten away.

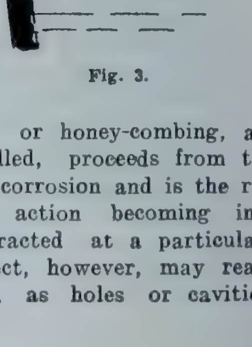


Fig. 3.

Pitting or honey-combing, as it is often called, proceeds from the same cause as corrosion and is the result of chemical action becoming intensified and contracted at a particular spot. This defect, however, may readily be perceived, as holes or cavities from

1-32 to ¼-inch in depth appear (see Fig. 3). Boiler explosions have been caused by grooving or furrowing, and usually takes place at a point where expansion or change of shape is localized.

External corrosion attacks stationary boilers set in brick work, and is caused by being placed in a damp location or from leakage or lodgement of water in contact with the plates. One case of external corrosion caused by brick work may be seen in Fig. 5. In this case the moisture drained from the surface, which was at a higher level into the centre wall, against the bricks, will conceal a leakage in the seams until the plate is seriously corroded. Less than two years ago one insurance company discovered over ten thousand cases, seven hundred of which were considered dangerous, thus we see the external corrosion is a foe that must be guarded against.

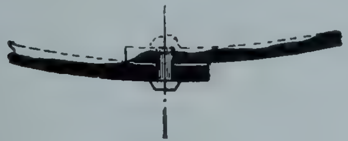


Fig. 4.

To Prevent Corrosion.

It frequently happens that it is cheaper to buy a new boiler then to change the feed water. In such cases the boiler should be frequently examined and cleaned to make it last as long as possible. When feed water is known to be impure and must be used, its effect can be neutralized by alkaline substance such as soda. Where water containing acid is used a filter containing straw will be found beneficial, or a very fine grade of refined mineral might be used. The plate becomes coated with a film of oil, thus preventing corrosion. However when this is used, the boiler should each day be partly blown off to ascertain its effect. Graphite paint, while not as effective, has in some cases been found a good preventive.

Another method of overcoming this enemy will be found in the use of zinc slabs, as considerable of this wasting away is caused by what is known as galvanic action, that is the generation of electricity. When two different metals are placed in a solution that act chemically on both, an electrical current is set up, and one is rapidly attacked and eaten away. Thus, as in a storage battery, this metal is known as the positive and the other as the negative.

Iron while in the absence of another metal is both positive and negative. In this way then a small quantity of zinc, say a slab 12"x6"x½, for each 70 h.p. fastened to the stays, forms an efficient protector from corrosion, and should be frequently removed. It must be admitted, however, that the action causing the slab to attract the corrosion is not always electrical, but if this is found to reduce the corrosion on the plates their use should be continued; grooving will to a certain extent be prevented by the application of the above means, although careful firing will do much to relieve the excessive strains due to expansion. External corrosion can to a great extent be prevented by so placing all seams in such a position that they can be inspected for leakage, which in most cases is caused by delivering cold water on the hot plates and by too rapidly emptying the boiler when hot. It will also be found advantageous to leave a few bricks in the centre supporting wall (which should not be more then three or four inches wide) loose so that an accumulation there may be prevented.

Incrustation.

The most common of impurities that exist in feed water are the limes and magnesia, but every section of the country has a different class of impurities, these substances are the principal causes of incrustation, or hard scale formation in boilers. This mineral matter forms partly into a sludge or mud, some of it into a fine powder, and the balance settles on the plates of the boiler as a hard scale. These solid particles when set free float around for a time, and then settle down on the tubes or other surfaces, where they are soon baked to the plate, and if some means are not taken to remove it, will soon reach a depth of ¼ or ½ inch.

To Prevent Incrustation.

There are two means of overcoming this difficulty, (1) chemical, (2) mechanical. While both of these methods have met with much success, there is one positive way, and that is to distill the feed water, but in this case the cost is practically prohibitive. Under chemical means we include purifiers or feed water heaters, this is a separate apparatus in which the water is heated before entering the boiler, and if the impurities are such as carbonate of lime and magnesia exhaust steam may be used to heat the water, as it is then possible to heat the water up to 200 deg. F. at which temperature the impurities precipitate out, usually as a whitish or grayish mud. These impurities, unless given time to settle, will find their way to the boiler, and it is for this reason that all heaters should have at least fifteen minutes supply.

The difference of impurities held in solution and those held in suspension might here be explained. As in the case of salt and water, thus it is with impurities held in solution, they become lodged between the molecules of water, and are not visible to the eye. Waters vary so much in kind and quality that there is no universal remedy for purification. Different waters require different treatment, a chemical examinination being the first step towards a remedy. Boiler compounds are the outcome of the necessity for purification.

Mechanical Methods.

Here consider filters composed of beds of fine sand, pebbles or bones which will hold back all earthly matter. The blow-out apparatus forms the most practical means, as all or the large part of the scale forming part, is naturally carried to the coolest part of the boiler, and may be removed by blowing off the boiler while under steam. This should be done when the fires are light or banked, and a small quantity blown off at a time, as there is less danger of burning the boiler if the valves stick.

Floating skimmers are placed on some boilers to collect continuously the floating impurities and by piping conduct them to a receiving chamber outside the boiler, where the sediment separates out, and the clear water returns to the boiler. The most effective method of removing hard scale is by hammering or chipping it and for this work only an experienced man who understands the work should be employed as there is great risk of injuring the boiler. A simple method is to allow the boiler to gradually cool and then stand full of cold water for a few days. The scale is then partially redissolved and on emptying the boiler is removed with the water. As time can not always be had for this method, however, other means which are more rapid must be used.

There are several mechanical devices on the market for removing hard scale. One of the best and in fact the general feature of them all is that of a small hammer made to knock rapidly against the side of the tube. Usually, compressed air or steam is used to actuate the hammer which vibrates from 3,000 to 4,000 times per minute, and experiment has shown that the force of the blow is insufficient to harm the tube itself.

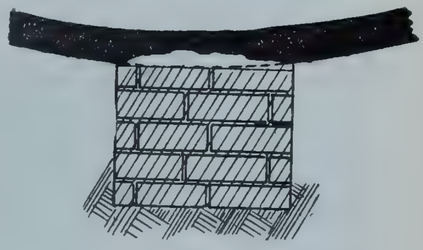


Fig. 5.

Boiler Explosions.

Upon three factors depend the life of the steam boiler, (1) design, material and workmanship; (2) the purity of its feed water, and (3) the treatment it receives in service.

The natural or normal life of a steam boiler is, for a locomotive type six years, while Lancashire or Cornish boilers have lasted from thirty to forty years. It sometimes happens that a boiler's usefulness is ended by an explosion, with loss to property which is enormous and often with loss of human life.

Cause of Boiler Explosions.

While there are numerous causes from which explosions proceed, they may be classified as weakness, and defect in design, material and construction, wasting from corrosion, wear and tear, and improper treatment and attention. While these causes are general, it will be remembered that explosions may be caused by a combination of causes. Fractures often occur as a result of the stays being too rigidly stayed, which interfere with the expansion, while unnecessary and dangerous fittings should never be used, such as a hand valve placed between the safety and the boiler.

Flaws sometimes originate during the progress of manufacture, and while the material is carefully inspected, and must conform to standard specifications, yet it sometimes happens that flaws exist that are overlooked and are a source of weakness. Badly fitted rivets, too brittle plates which often cause cracked rivet holes, and caulking tools of improper shape which cut the skin of the plate, thus starting a groove and consequent wasting away are some of the many causes. The best methods of preventing explosions may be stated as follows: Efficient periodical inspection, maintenance of boilers in good condition, the employment of trustworthy and competent attendants. Inspection should continue after a boiler is installed until it is declared unfit for further service. Inspection by an outside party at least once a year is conducive to safety, and should be both internal and external. The inspector should rely upon the hammer test as it has been shown by experience that this is the best method of detecting flaws, as the difference in sound is soon revealed to the trained ear.

Regulating the Supply of Feed Water Automatically

One of the Greatest Economies in the Boiler Room is Effected When the Water in the Boiler is Maintained at a Constant Level. A String on the Gauge Glass and an Eye Constantly Upon it, is the Method Often Followed by Engineers. If This Water Supply can be Regulated Automatically it Saves the Engineer's Time, Avoids an Excessive or Lack of Water Supply, and Results in a Constant Economy. The Bice Regulator, Recently Placed on the Market, has This Economy in View.

THE Bice regulator is a self-contained brass casting shown in the illustrations, and may be placed on any steam boiler, stationary, portable, locomotive or marine.

Its purpose is to automatically keep the water at a constant level in the boiler without the attention required when such a device is not in use. The device has been used for over three years in a saw mill boiler and the level of the water has not varied over one quarter of an inch in that time, except when altered by hand for some special reason.

The Bice regulator is applied to single boilers feed by means of a steam pump without the use of any other valve..

When used in connection with belt driven feed pumps on single boilers, a special regulator is supplied for the purpose which is practically the same as the one used with steam pumps, only by placing it on the discharge line of the pump, it controls the excessive water to the boiler and returns the surplus water to the heater or reservoir.

This device is applied to a battery of any number of boilers. All feed from one pump, and will, it is claimed, keep the feed water at a constant level in each boiler no matter what the pressure on each particular boiler may be.

It is used on feed water heaters of the open type in a similar way as when applied to a boiler and can be used to keep a stated level of water in any open reservoir.

On steam heating boilers of any type it can be applied with the same results as when used on ordinary boilers for power purposes.

For marine boilers, the Bice regu-

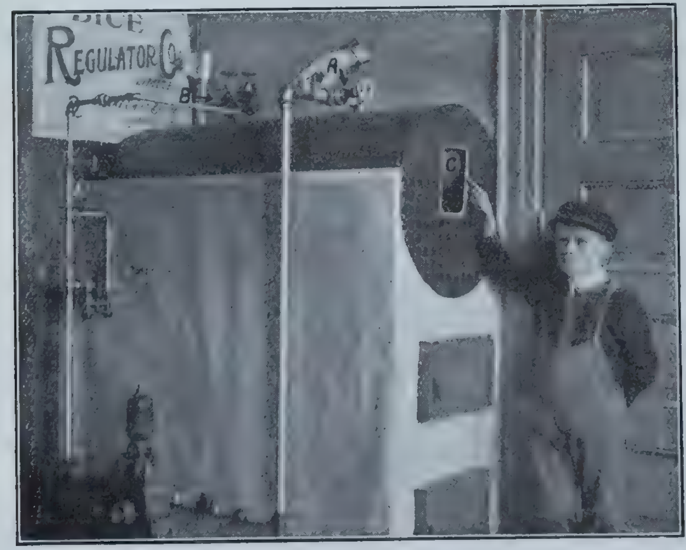


Fig. 1.—As Water Raises, Float C is Raised and Closes.

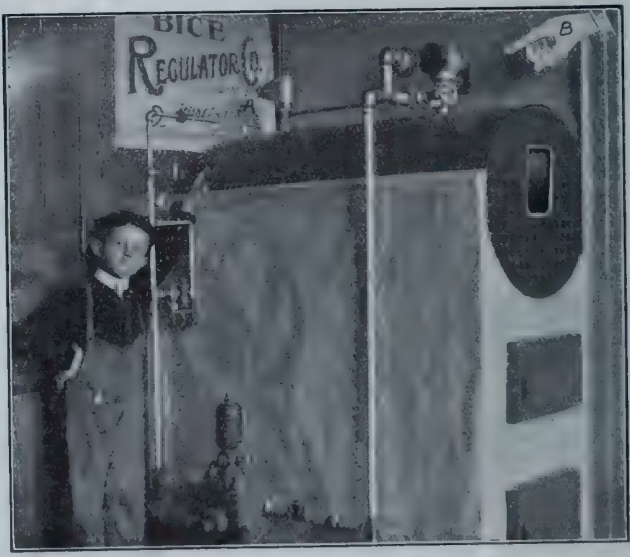


Fig. 2.—Water Supply Controls Pump.

lator can also be used, and will keep the water level.

In locomotive practice, it is not found practicable to use the Bice regulator when an injector is used for feeding the boiler but at the present time the railway companies are commencing to use a small steam pump for that purpose and in that case the regulator can be successfully applied.

On portable and traction engine boilers, when using steam feed pumps, the Bice regulator has been successfully used on a large number of such outfits in Canada and the United States for threshing, plowing and other purposes.

In Fig. 1—A is the water feed pipe, B is the steam pipe and C the float. As the water raises, the float C also raises shutting off the ports.

The Bice regulator is manufactured by the Bice Regulator Co., London.

Webster Feed-water Heater at Montreal Steel Works

A Typical Illustration of a Webster Feed Water Heater, Purifier and Filter has Been Made at the Montreal Steel Works, Montreal, by Darling Bros., Montreal. The Webster System of Heating is in Use in the Works, Full Provision Being Made for the Handling of Condensation, Oil Separation From Exhaust Steam, etc.

THE accompanying cuts illustrate a typical installation of the Webster Feed Water Heater, Purifier and Filter, at the Montreal Steel works, Montreal. It is of the standard Webster type—an exhaust steam water heater, in combination with a filter and precipitating chamber complete in all details.

The heater is further provided with a Webster oil separator, which is made a part of the heater construction, which effectually and completely removes the oil present in the exhaust steam before it enters the heater, water-sealed overflow, blow-off or drain, charging and cleaning doors for the filter, sealed outlet for the heated and purified water fed to the boiler feed pumps, gauge glass, and combination vent and inlet air valve.

The materials used in its construction are cast iron for the shell, copper and brass for the valves and fixtures, each of which resist the destructive action of impure waters. The large heating chamber—upper section of the heater—is provided with perforated copper trays for the distribution of water as hereinafter explained. The entire valve gear, automatically controlling the water supply, is of brass. This heater heats the feed water for 5 130 h.p. boilers, 4 of which are constantly running and one spare.

The exhaust steam from three Burnham 10 x 6 x 12 pumps, and one 25 h.p. vertical engine driving the water circulating pumps, or condensing plant, is used to heat the water in the heater. The pumps A and B are 10 x 6 x 12 Burnham brass-fitted boiler feed pumps. Pump B is used for circulating cooling water for the air cylinders of a steam driven cross compound air compressor, after which the water enters the Webster heater.

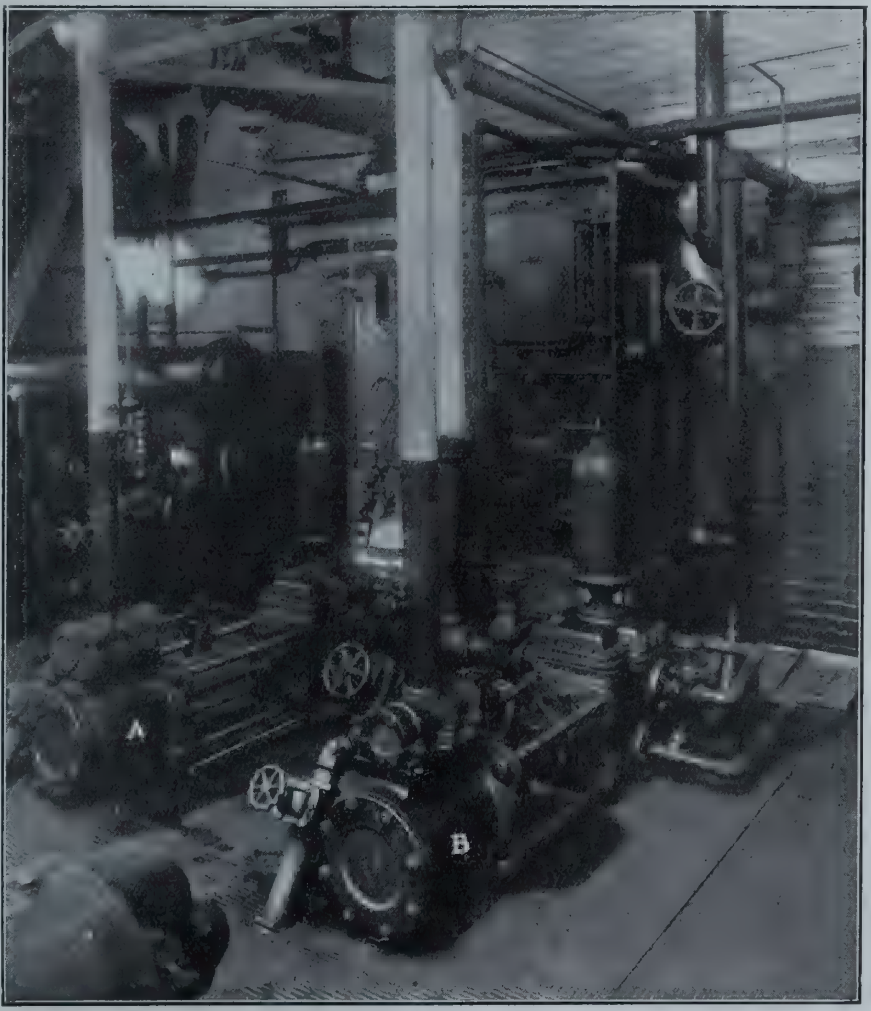
Boiler Feed.

Pump "A" feeds the boiler with hot water drawn from the hot well in the Webster heater. The temperature of the feed-water is kept at between 200 degrees and 210 degrees Fahrenheit constantly, with Webster heater. Both pumps are so connected that either one could be used for boiler feeding.

Heating System.

The Webster vacuum system of steam heating is installed in this company's works. The condensation is drawn from the system by a Burnham vacuum pump which discharges the return into the Webster heater. There is a cold water connection to the heater, the water passes through a 1½ inch regulating valve which is operated by a float in the hot well of the heater so that cold water is automatically admitted to the heater, if for any reason the water level gets low in the hot well. The filter bed is made of clean coke, this bed is changed every three months and is washed about every three weeks.

Both the Webster heater and the Burnham pumps are manufactured in Montreal by Darling Brothers, with offices in Toronto, Winnipeg, St. John, N.B. and Vancouver.



Installation of Webster Feed Water Heater and Burnham Pumps at Montreal Steel Works.

Facts About Water for Boiler Feed and Other Purposes

By W. A. Converse *

Engineers as a Rule Know to Their Sorrow, the Results of Feed Water on the Boiler, But Perhaps Some of Them, it May be, a Great Number of Them, do Not Know the Cause That Produces the Results. To Remove the Bad Effects of Impure Feed Water One Must Get at the Causes, Mr. Converse Points Out the Causes and Suggests How the Troubles May be Eliminated. He States That Money Spent in Having an Analysis of the Water Made is Money Well Invested.

WHILE the ill effects of waters used as steam boiler feed supplies in power plants have been for several years, to a certain extent, and are at present, in a general way, known to the owners and operators of the plants, the causes back of these effects are no doubt not very well understood, at least by many. For every effect there must be a cause; and as different waters have different effects in the same plant, and the same water different effects in different plants, it is plainly to be seen that the successful obviation or overcoming of these troubles is dependent upon a thorough and careful investigation along more lines than one, as the greatest differences in effects are shown by the use of different waters, such as scale formation from the use of one, foaming and priming from another, and corrosion from still another.

We must conclude that these differences are due, first, to a difference in the kinds of substances contained; second, to a difference in the total amount of substances present; and third, to differences in the relative amounts of the several substances contained.

By ancient philosophers water was considered one of the four elements; namely, air, water, fire and earth, the simplest form in which matter could exist. Many years since, however, skilled chemists by diligent experimentation discovered that water is not an element or simple substance, but a chemical compound composed of two elements; namely hydrogen and oxygen, in the proportion of two parts of hydrogen and one part of oxygen by volume, or two parts of hydrogen and sixteen parts of oxygen by weight. Hydrogen when pure is a colorless, odorless and tasteless gas; inflammable, but a nonsupporter of combustion. Oxygen when pure is also a colorless, odorless and tastless gas, non-inflammable, but a very strong supporter of combustion.

To the chemist water is an extremely interesting substance, as it is one which furnishes an excellent example of the thorough alteration which matter may undergo when it takes part in chemical action. For example, if we were to take two gallons of hydrogen and one gallon of oxygen and mix them in a suitable container, no change in the condition of either gas would take place; we would have only a simple mixture, as simple as would be a mixture of sawdust and water. But if we apply a flame to the mixture of the two gases, an instantaneous chemical action takes place, wherein the gases combine completely with an explosive effect, producing therefrom pure water. If desired, we can, by the use of electrical energy, bring about a disassociation of these gases, obtaining them in their original form, and of the same high purity.

Foreign Matter in Water.

To the chemist the term "water" implies water in a pure condition; that is, free from any foreign substance, either gaseous or solid. For present consideration we can judiciously assume that water has its origin largely in the seas, and to a less extent, lakes, rivers and ground surfaces, from which it is evaporated, the vapor rising and forming clouds, which, due to a change in temperature alone, or together with other climatic conditions or disturbances, are condensed or converted into their original form, and fall to the earth in the form of water. In falling through the atmosphere the water picks up more or less of certain gases, such as carbondioxide (C O-2), nitrogen, ammonia, and sulphur gases, the quantity of those so dissolved varying in different localities, dependent upon the quantity of such substances contained in the atmosphere itself. In manufacturing localities where coal high in sulphur content is principally used as a fuel, the sulphur gases, in particular, are much higher than in the rural districts. This being the case, these gases are picked up by the water in greater quantities in such districts than in others. The quantity of carbonic acid gas varies also in different localities. The nitrogen and ammonia vary somewhat less. Immediately following the contact of the rainwater with the surface of the earth, more carbondioxide, nitrogen, and ammonia are taken up, these gases being a resultant product in the decay or oxidation of vegetable matter (decay being only a process in oxidation or burning.) In passing from the surface into and through the different strata below, the water takes up the solid mineral solids common to them, the kinds and quantities of the solid substances dissolved or taken up being dependent upon the composition of the strata through which the water travels. If it were not for the carbonic acid gas which the water had previously picked up while falling as rain, and upon the immediate surface of the earth, practically no carbonate of lime could be thereafter dissolved. When this gas is present, however, through the solvent action of the water when it reaches geological formations composed more or less of carbonate of lime or magneisia, or both, these substances are readily dissolved, in some cases to a comparatively large extent.

River or Lake Water.

The same conditions exist in the water from rivers, lakes, and so forth, the kinds of substances contained in the water being dependent upon the composition of the geological formation over or through which it travels, or upon which it rests. If during its course of travel it passes over formations rich in sulphate of lime, this material being more soluble in the water in the condition in which it exists than carbonate of lime, is readily dissolved, and becomes a part of the soluble matter contained in the water as submitted to the chemist. In this manner can the presence of most of the substances found in water be explained and accounted for.

Other substances, however, are not uncommonly found, which are due to different conditions, referring now to the mineral acids, more particularly sulphuric acid (oil of vitriol) and hydrochloric (muriatic) acid, the former being very common in mining districts where the waste or refuse from the mines accumulates upon the surfaces about. This refuse or waste carries as one of its prominent constituents, sulphide of iron, commonly known as Pyrites, or "fools' gold," which chemically is a compound made up of iron and sulphur. Upon exposure to atmospheric conditions, the sulphur contained in this compound readily combines with oxygen from the atmosphere, and when further combined with water, produces sulphuric acid, which naturally drains off into the streams, slumps, etc., thereby seriously contaminating the water, oft-times to the extent of converting one of moderately good quality into a water absolutely unfit for any puruose. Hydrochloric, or, in other words, muriatic acid, is not particuarly common in waters such as are considered for technical purposes. Wherever found it constitutes contamination, usually traceable to waste affluents or sewage from manufacturing plants in which this acid is used in the process of manufacture and, not all being neutralized or changed by chemical combination into other substances, remains in a free state.

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* Chemical Director, Dearborn Drug & Chemical Works, Chicago.

Solids in Water.

It no doubt will prove of interest to the reader to know something about the large quantity of solids it is possible for water to hold in solution. Therefore, the writer cites the following from an article published by D. Jolly (after years of investigation and study) in the Scientific Transactions, Royal Society, Dublin, in the year 1899: "The average salinity of the ocean is not far from 3½ per cent. Its main density or specific gravity is 1.027, and its volume is 302,000,000 cubic miles. The specific gravity of the salts held in solution, as nearly as can be computed, is 2.25. From this data it can be shown that the volume of the saline (solid) matter in the ocean is a little more than 4,800,000 cubic miles, or enough to cover the entire surface of the United States, excluding Alaska, to a depth of six miles."

He further estimates that the sodium chloride (common salt) in the ocean would cover the entire globe to a depth of 112 feet. In this same connection, according to an estimate made by Sir John Murray, and published in the Scottish Geological Magazine, Volume 3, page 65, the total annual rainfall upon all the lands of the globe amounts to 29,347.4 cubic miles, and of this quantity 6.524 cubic miles drain off to the sea. A cubic mile of river water weighs approximately 4,205,650 tons, and carries in solution, on the average, 762,587 tons of solid matter in solution. In all nearly 5,000,000,000 tons of solid substances are thus carried annually to the ocean.

The quality of water has to do with the quality of results obtained in practically all manufacturing processes in which it is used. In case of those used for laundry purposes, it is desirous to have at hand the softest water possible, in this case water absolutely free from all substances in solution being superior. In the processes connected with the dyeing of fabrics and materials of all kinds, it is absolutely essential that a water devoid of certain substances, at least, must be at hand. When considered for use as a steam boiler feed supply, it becomes of not only equal, but greater import, as no doubt greater loss and poorer economy result from the use of an unsuitable water for this purpose than is the case in most processes of manufacture where the quality of the water has to do with the products manufactured.

The substances dissolved or picked up by the water in its travels, as before outlined, vary in kinds and quantities, consisting of silica, oxides of iron and alumina, carbonates of lime and magnesia, sulphate of lime, sodium chloride (common salt), sulphate of soda, and carbonate of soda, together with many other substances which we will not mention at this time. The carbonate of lime and magnesia, together with the sulphate of lime, contsitute those which, when present in a water used as a steam boiler feed supply, are responsible for the formation of scale or incrustation. The alkali salts; namely, sulphate of soda (Glauber's salts), chloride of soda (common salt), and carbonate of soda (soda ash), being extremely soluble, not only in cold water, bnt much more so in hot water, do not enter into such formation, but are constantly increasing in quantity in the solution remaining in the boiler from time to time, due to the fact that each gallon of water entering the boiler carries with it its pro rata of these salts, and when leaving the boiler in the form of steam, leaves without them all, with the exception of possibly a minute trace which is carried in solution in the moisture or water carried over mechanically with the steam.

Alkali Salts.

The alkali salts give to water the property, however, of causing trouble, ofttimes more serious than scale or incrustation; namely, corrosion, pitting, etc., and also foaming and priming, together with, in many cases oozing out at and causing leaky joints destruction of gaskets, etc. In some cases, these soluble salts have been allowed to accumulate in the boilers to such an extent that there are more contained in solution than is possible for the water to hold, consequently they crystallize out upon the surface of the tubes and sheets. When this happens, it is almost certain that serious trouble in the way of bagging of the sheets or tubes will very soon follow.

Mineral Acids.

The presence of mineral acids, either sulphuric or muriatic, or both, is extremely objectionable, and even in small quantities they demand more careful consideration than do almost any other substance common to waters used for the purpose under consideration. If the water contains muriatic acid, this acid being volatile, is readily converted into vapor, carried over with the steam, and with it through the entire steam system. It has the property of dissolving all metals with which it comes in contact, consequently would set up serious corrosion, more particularly in the steam space through the steam lines, engine cylinder, etc., than elsewhere. In the case of sulphuric acid the results are different, this acid being non-volatile or, in other words, not converted into vapor, under the conditions existing in the interior of the boilers, but accumulating from time to time in the boilers, in the same manner as outlined in connection with the alkali salts above referred to, until eventually the concentration of the solution in the boiler is that of a moderately strong, sulphuric acid. This acid also has the property of destroying all metals used in engineering practice, and would immediately attack all surfaces below the water line, which would soon result in serious damage.

Effect of Pure Water.

The effect of too pure water in steam boilers is such as also to demand much consideration. The use of rain water, which is practically pure, is ill-advised, as it is extremely corrosive, and results in practice have been such as to prohibit its use, even though a sufficient quantity were at hand for the purpose. Corresponding very closely to rain water, we have in plants running condensing the condensed water obtained thereby. The action of condensed water is identical with that of rain water, except that it is usually not so vicious. This is accounted for by the fact that the condensed water carries none of the gases referred to as being picked up from the atmosphere by the water in falling as rain. While the final effects of condensed water are of the same character as those of rain water, they are brought about in a different manner. In the case of condensed water, there are present no gases in solution to which can be attributed the cause, but they are found in chemical combination in the water itself; consequently, if under the conditions there is a decomposition of the water or, in other words, a disassociation of the gases contained, the oxidation (corrosion) of the metal of the sheets or tubes with which the gases come in contact, can readily be accounted for. In the writer's opinion, this is not only possible, but probable, and furnishes an explanation of the corrosive effect of distilled or condensed water.

Presence of Oil.

The presence of oil in condensed water is the rule rather than the exception, as it is picked up by the steam in its travel through the cylinder of the engine, and carried along mechanically until the steam is condensed, becoming a part of the condensation. Oil when present in a boiler feed water, even in minute quantities, demands more than ordinary consideration; first of all, along the lines of removal from the water, so far as possible, before it enters the boiler, followed with the use of suitable chemicals to counteract all possible deleterious effects of the oil remaining in the feed water. The oil after being deposited upon the interior surfaces is, due to continued heating, changed from time to time, portions being converted into vapor which rises and passes off with the steam, leaving a harmless appearing deposit, but one which, owing to its ability to prevent proper transmission of the heat, will very probably cause overheating of the metal, resulting in burning or bagging them. Even a drop of oil on the sheet or tube may result in bagging.

Where live steam is used direct in the processes of manufacture of many products, the chemist or firm considering the subject must not lose sight of the importance of not only a careful study of the substances originally contained in the water, but also that of the reagents which he or they propose to use for the overcoming of boiler troubles. In breweries, distilleries, artificial ice plants, and those manufacturing or putting up food products, special care and study is necessary in order that all volatile substances contained in the original water may be converted into non-volatile ones, and no volatile chemicals used in the treatment, and none formed or produced by the reactions which take place between the substances contained in the feed water and the treatment used, thereby obviating completely contamination of the final product by the live steam taken from the boiler.

Granting the foregoing, the first and most essential step in such investigation is to have an accurate and complete analysis of the water, in order that knowledge may be had as to the total amount of solid matter contained, as well as the amount of each individual substance contained. It has been thoroughly demonstrated to the writer during an experience of nearly twenty years in the analyses of waters used for steam boiler feed purposes, he being in close contact with the operation of steam plants wherein the results obtained in practice from the use of hundreds of different waters were noted, that it is not only possible to foresee the deleterious effects of a water by a perusal of the correct analysis, but to be able to render a correct and accurate statement as to the actual results which will be obtained, assuming, however, the use of such waters under ordinary and average conditions.

Since, as previously stated, the same water has different effects when used in steam plants, even though they be constructed along similar lines as near as possible, having an installation of the same type, and in other ways practically the same equipment, it is essential also that serious consideration be given the installation, noting in detail, and particularly any differences in the conditions under which they are operating.

In conclusion, it is the belief of the writer, that an exenditure of even a liberal amount of money in the investigation of the quality of the water to be used for any manufacturing processes as a boiler feed supply, etc., would constitute a judicious and well paying investment, even to the extent of an investigation of the possible water supply, that is, the quality thereof, before the final selection of a site for the plant; and where it were dependent upon a water of poor quality the location to be obviated, if possible, unless otherwise offset with absolute certainty by other things having to do with economic operation.

The Fuel Economizer; Its Relation to the Feed Water

By Fred H. Moody, B.A.Sc.

The Fuel Economizer as a Means Toward Decreased Operating Costs, and Therefore Greater Economy, Does not Seem to be Fully Appreciated by Canadian Engineers, the Information to be had on the Subject Apparently Being Limited. The Main Economies Obtained are here Briefly Dwelt Upon, and the Minor Advantages, Which in Many Cases Prove to be the Most Important, are Dealt With More Fully, With Special Reference to what the Fuel Economizer Will do Towards Improving the Feed Water, and Relieving the Boiler of the Strains From Feed Water That is Cold and Bad.

THE Fuel Economizer has not as yet come to be recognized as an essential part of a well-designed power plant in this country, and, in fact, but little is known about it, so few are the installations in Canada. Essentially it is nothing short of a plain feed-water heater, with the exception that, in the latter case, it is the exhaust steam that is operative in heating the feed, preparatory to injecting into the boiler, whereas in the former instance, the remaining heat in the spent flue gases are utilized, the degree of the heat extraction depending on the ratio of economizer to boiler surface, forcing, and other equally important considerations. That they have "made good" is sufficiently proven by their extensive introduction into large power plants in the United States and abroad, especially in England, where the idea was first put into practice, by Edward Green, in 1845. The London Exhibition of 1851 brought it extensively into the limelight, since which time economizers of various makes have made the rapid headway just mentioned.

To all intents and purposes, the economizer is merely an extension of the boiler heating surface, consisting of cast iron pipes arranged vertically in rows or sections which communicate with each other through top and bottom connecting chambers or headers. This construction is clearly shown in Fig. 1, which is of a small type of economizer.

In the earlier styles of economizers great difficulty was experienced from the tubes becoming encased externally with a layer of soot, the latter tending to diminish the conductivity of the surface, soot having low heat-carrying capacity. It seemed that this was to prove its undoing, handicapping the early manufacturers. However, the difficulty was overcome by means of mechanical scrapers. These scrapers, shown in Fig. 1, consist of cast iron half segements, bolted together to fit snugly over the pipe, and which are automatically lowered and raised, by the mechanism shown at the top of the economizer, which in turn is driven from a small engine. By this system most of the soot is scraped from the tubes, the heat conductivity of the tubes being but slightly diminished. This mechanical scraping has proven to be much more satisfactory than the system used in the early days —the removal of the soot by a steam blast. While most of the soot would be blown away, a thin film would be left each time, the steam blast tending to cause it to cake, eventually forming a thick, non-conducting layer.

Fig. 2 shows the usual method of installing economizers, a double passage being provided from the boilers to the stacks, in the event of the failure of the economizer, and also to permit of its being cleansed without shutting down the plant. The hot gases leave the boilers A, pass through flue B, and enter the economizer at C. The gases then pass between the economizer pipes filled with feed water, heating the water to a high temperature. After reducing their heat in raising the temperature of feed water, the spent gases pass through flue D to chimney E. The feed water from pumps F passes through the economizer pipes, and enters the boiler through pipe G, having been greatly raised in temperature by the hot gases. H is a by-pass damper which compels the gases to go through the economizer. I and J are dampers by shutting which, and opening H, the gases can be passed directly to the chimney. This is for reasons already mentioned. It will be noticed that the feed water enters the economizer where the gases are coolest, and leaves where they are at their highest temperature, where they leave the boiler. This gives the maximum heat transmitting arrangement.

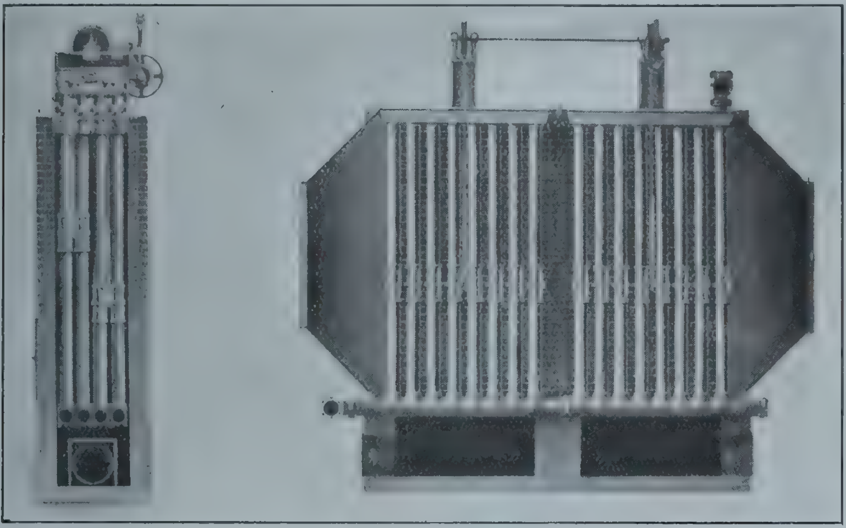

Fig. 1.—End and Side Views of a Small Fuel Economizer.

Two different arrangements of pipes are in vogue — straight and staggered rows, the exponents of each claiming superiority for their own particular type, though each has its advantages, and needless to say, disadvantages. The two types are clearly illustrated by Fig. 3. For the staggered, it is said that, as the pipes in one section are placed opposite the spaces in the adjacent section, the hot gases must envelop the cast iron water pipes, and impart their heat more quickly than when passing on the sides only of the parrallel rows. On the other hand, it is pointed out that the absorption of heat by the tubes is determined, not so much by the impingement of the gases upon them, as by the difference in temperature between the gases outside and the water outside. This would not be exactly true if the tubes were far apart, and the velocity of the gases high, but, as economizers are actually constructed with tubes close together, there appears to be much truth in this statement, especially when the decreased draft caused by the staggered pipes is considered.

But little need be said with regard to the economy of heating the feed in the economizer before introducing into the boiler, for this is pretty thoroughly understood, and the resulting economy recognized. It is an established fact that the rate of heat transmission from gases to water through metal plates is proportionate to the difference of temperature and to the rate of flow of the gases. (Just here it might be said that this proportion depends on the condition of the tube surfaces, thus impressing the necessity of the soot cleaner previously mentioned.) Thus the parts of a boiler most effective in evaporating water are those nearest the fire, where the heat is most intense. As the rapidly cooling gases move forward to succeeding parts of the boiler surface, and approximate in temepraturе to the boiler contents, the rate of transmission becomes less and less, so that the boiler surface must be extended infinitely if the gases are finally to reach its temperature. Fig. 4, taken from actual tests, show that in this particular instance, the last 40 per cent. of the heating surface are of but little use.

Experiments show that in most commercial boilers, the water and steam are of one temperature throughout, corresponding to the steam pressure, so that the temperature of the steam is the limiting temperature to which the gases can be brought. If the boiler pressure is high, the temperature is correspondingly so.

In the economizer, boiler pressures prevail, and as the maximum temperature is that of the boiler, the average temperature is lower, so that much heat can be picked up from the gases that are customarily considered to be spent. With feed water at 150 degs. Fahr., the saving has been found to be 56.3 per cent., and 51.8 per cent. with the feed at 200 degs. Fahr. It is thus advisable to use an economizer in place of the useless 40 per cent. of the boiler, before mentioned.

In addition to the gains just mentioned, which, while great, are not the only ones obtained by any means, there are some very important secondary benefits obtained, gains which deal exclusively with the feed water. Prominent among these is the huge reservoir capacity for hot feed water that the economizer provides. It has been demonstrated that with the usual ratio of boiler to economizer heat-

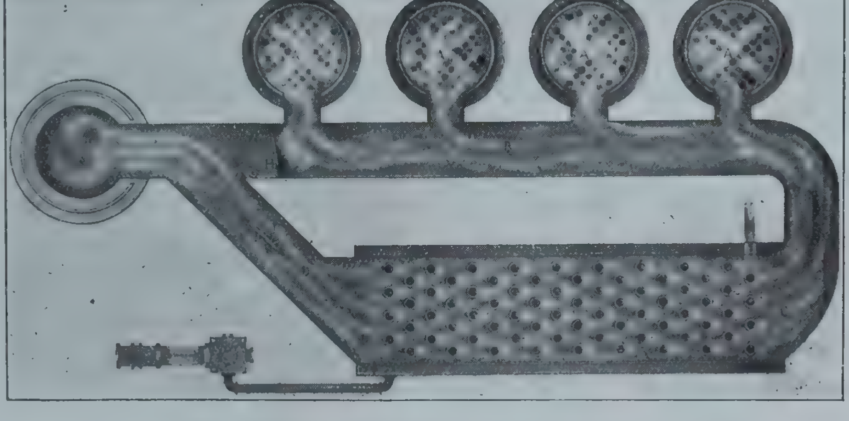

Fig. 2.—Fuel Economizer Arrangement With Regard to Boilers, Stack, etc.

ing surface, there is a reserve equivalent to about an hour's steam consumption ready for immediate use at times of emergency. This feature is particularly desirable for central station work, where the peak load late in the afternoon, or before a storm comes on very suddenly, overloading the boilers, which are relieved of much of the work that would otherwise be imposed upon them if it were not for the presence of the large reserve of hot water. Then again, the more the boiler is forced, the hotter will be the flue gases passing to the economizer, supplying the latter with the wherewithal to produce the hot water more rapidly. The hot water being evolved into steam in a lively manner, increases the rate of flow of the feed through the economizer tubes, and as the heat conductivity increases with increased circulation, this presents another advantage in sustaining overloads for short periods.

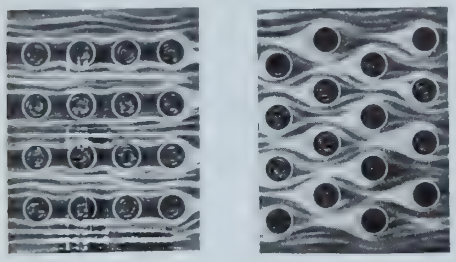
Fig. 3.—Straight and Staggered Arrangements of Pipes.

Cold feed water proves very detrimental to boilers, introducing secondary strains that in many cases bring the fibre tension in the boiler steel near the danger mark. Economizers from their construction, in rows of tubes, each row secured to its independent header, are not liable to experience any dangers from contraction strains. Each tube in any particular row is heated to the same amount, and the feed water is injected at a point where the gases have been decreased in temperature to a marked degree, so but little chilling effect is occasioned. An example will show the extent of the strains set up in a boiler by the cold feed water. If cold feed water reduces the temperature of a strip one foot long by 170 degrees, the strip will tend to shorten .001139 feet, as steel contracts or expands .0000067 of its length per degree change of temperature. If the remainder of the boiler holds this piece rigidly at its ends, it will have to stretch this amount requiring a force of 33,041 pds. per sq. in. of section. This aded to the normal working stresses, comes dangerously near the elastic limit.

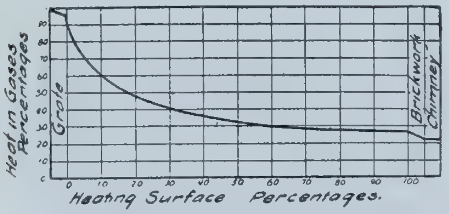

Fig. 4.—Boiler Heat Absorption Chart.

The economizer further precipitates many of the impurities found in feed water and, because of the slow motion of the water in the tubes, these precipitates fall to the bottom when they are easily blown off or washed out as sludge, while if they had been allowed to proceed to the boiler they would have become baked onto the tubes as hard scale. That considerable scale forming material is eliminated from the boiler feed is shown by the fact that from time to time it is necessary to remove the scale from the tubes of the economizer, besides the regular blowing off to which it is subjected. This scale which forms on the tube, in place of being hard. as in a boiler, is quite soft, and is readily amenable to merhanical cleaners, due to the fact that it is not subjected to as high temperatures as the scale on boiler tubes, the heat striking the scale in the latter case, becoming more intense, as the scale becomes thicker from its low conductivity.

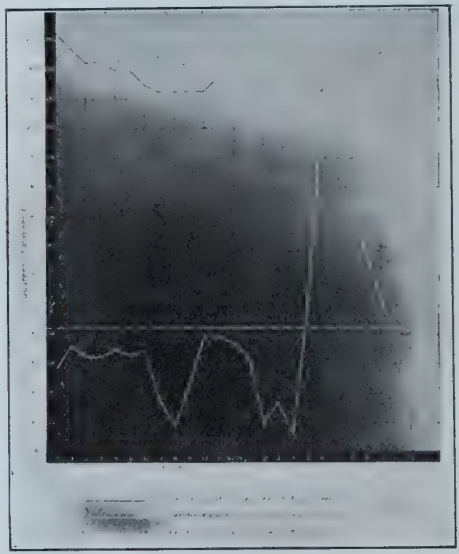
Fig. 5.—Chart Showing Rise in Temperature of Feed Water Passed Through a Fuel Economizer.

The bicarbonates of lime and magnesia are the most prevalent scale forming substances in water. These, however, are easily precipitated if the water is heated to from 200 to 210 degs. Fahr., because of the conversion at that temperature of the bicarbonate into monocarbonate, the carbon dioxide being set free, and the monocarbonate, which is insoluble, precipitated. The sulphates of lime, while not amenable to this treatment, become insoluble in part above 270 degs. Fahr., a temperature nearly always reached in an economizer, as shown by the performance curve, Fig. 5. At high temperature some of the magnesia salts are decomposed, and left behind, so that the fuel economizer is seen to act as an automatic feed water softener, for with no particular treatment, it leaves the feed soft for boiler injection.

Being hot and pure relieves the boiler of much of its work, the number of leaky tubes and seams, and cracked plates commonly found by boiler inspectors, under ordinary circumstances, on their tours of inspection, testify to this.

FERNIE POWER PLANTS.

The capital invested in the municipal electric light plant which supplies the city of Fernie amounts to $56,000. The capacity of the plant is as follows: Generators, 300-kilowat energy; 400-horsepower engine, supplied from a battery of three boilers of a combined capacity of 450 horsepower. The connected load is 240 kilowatts, of which 74 are used by motors. A 24-hour service is supplied. The rates charged are as follows: Lights, 15 cents per kilowatt hour, less 10 to 40 per cent. Power, per kilowatt hour: Up to 150 hours 10 cents, minimum per month $12; 150 to 300 hours, 9 cents, minimum per month $15; 300 to 600 hours, 8 cents, minimum per month $27; 600 to 1,200 hours, 5 cents, minimum per month $48; 1,200 to 2 500 hours, 3½ cents, minimum per month $60; over 2,500 hours, 2½ cents.

The city council is considering propositions for substituting water power for the steam now used, and it is estimated that a considerable saving can be made by buying power of some company which is in position to furnish it by transmission in large quantities.

An American company is now installing a water plant at Bull River Falls, about 17 miles in a direct line west of Fernie. This company is taking water from above the Falls through a flume 8 by 16 inches, having a fall of over 300 feet at the outlet. The stockholders are from Chicago, Omaha, St. Paul, and other western cities, and it is the intention of the company to gradually utilize all the available water in the stream.

WANT SOFT WATER.

The manufacturers of Winnipeg, representing practically every industry, went on record as wholly in support of a plan to secure a supply of soft water for the city. They claim that half a million dollars' damage is done annually to boilers, pipes and utensils generally by the hard, alkali water used at present.

Feed Water Troubles

By A. M. Wickens*

The Engineer in Charge of the Small Plant is Constantly up Against a Hard Proposition to Keep His Boiler Clean. Having Only One Boiler Adds to his Difficulties, and it is Essential to Have a Boiler Compound, Boiler Cleaner, Feed Water Heater, or Softener, That Will Assist Him in his Endeavor to Produce Cheap Power. If Scale is Allowed to Collect, the Coal Bill is Increased, and the Employer Does not Forget to Bring it to the Engineer's Attention. There is Room for Education of "Bosses" as to the Value of Feed Water Cleansers and the Proper Treatment of Feed Water. In Order That Both Engineer and Boss May Know Just What the Troubles are, "Dad" Wickens has Pointed Them Out in Order That Both May Select Carefully the Best Cure and Treatment for the Boiler Feed Water.

THERE has been so much written during the last few years in the mechanical press, in pamphlets and in every advertising device that can be conceived, that one would think that the last word had been said about boiler compounds and feed waters. We have been treated to long and scientific lectures by men well versed in chemistry, about the composition of all scale forming properties carried by most of the waters used for boiler purposes; we have seen carefully prepared tables showing the combinations of the different salts, and also the results in other salts that are produced when certain chemical salts are mixed with the feed water. We have also been told by other eminent chemists that we should not use chemicals in any form in our boilers, that all forms of soda are injurious and nothing but vegetable matters should be used, we have also seen stacks of literature advocating some one compound as a perfect solvent for any and all waters, all these backed up by scientific statements, by letters of recommendation from eminent and leading engineers, by statements that the makers are very reputable and wealthy firms with millions of dollars invested in business. These are only a few of the many statements made to the engineer and his employer.

I want more particularly to speak of the engineer in a small plant, one who perhaps has to do his own firing, run the engine, take care of all the belts in the plant, "and spend his spare time" in making himself generally useful to his employer. Men in plants of this kind, and we have a great number of them in Canada, cannot be expected to know anything about chemistry, and sometimes do not have the power to purchase anything for the plant, consequently they have to use material purchased for them by the boss or the foreman who know less about the requirements than the poor engineer. This leaves him with a difficult feed water trouble on his hands. This engineer has another difficulty. There is only one boiler, the factory is very busy, and it cannot be shut down for anything. The old boiler makes steam for the engine all day, and the night watchman tickles her up all night for the dry kilns, or some other purpose. The boiler is doing double duty, adding scale day and night. The only time it is possible to get her cool is Sunday. It had steam on it at 8 o'clock Saturday night.

Washing it Out.

Sunday morning Engineer Jim comes in to have a wash out, lets the water out of it, takes off the cover plates and finds her very hot. He tries to cool her off by using cold water and the hose; it must be cleaned out and have steam on Sunday night. Jim knows it is making scale rapidly, but it is too hot for anyone to stay in her and scrape or knock the scale off, so it is washed down, scraped a little and closed up for business, and another month or six weeks of steady steaming.

Using More Coal.

Now the boss discovers they are using more fuel than they used to do and comes to Jim to know what is the matter.

Well Jim says it is scaling up and he cannot keep it clean. The boss says, what's the matter with the compound? Jim frankly admits that he don't know, says he is doing the best he can but the scale is gaining on him. The boss then changes the compound, but the results are not much better, finally the tubes have to come out in order to clean them and the shell.

The compound man will say that fellow did not get the right compound or that he is too stingy to use enough of it.

Cost of a Clean Boiler.

Take a case in point of a 100 h.p. return tubular boiler being operated at a place where the sulphate of lime predominates. The owner had the water analyzed and received a compound said to be exactly right for this water. It seemed to work fairly well, but still the scale did not decrease, the amount of compound was increased until the cost of compound was $125.00 a year; the boiler was washed out monthly at a cost for extra wages and packing of $5.40 each time, making $64.80 per year. This made $189.80 per year or enough to retube the boiler each year. By this it will be seen it is very easy to go into an excessive cost for keeping a boiler clean.

Large Plant.

The smaller steam plants are usually the most troublesome to keep clean. In a large plant there is usually a spare boiler, thus giving an opportunity to have the boiler cold for cleaning. These plants also are better equipped with hose, scrapers and appliances. A man can give the boiler an extra dose of something that will loosen the scale and by keeping it simmering for several days, loosen all up so that it can readily be removed. Besides all this the engineer in the large plant has the power to get what he requires to keep the boilers clean, and will be able to keep the cost down to a minimum.

We are told that 1-16 inch of scale require from 10 to 13 per cent. more fuel, and the thicker the scale is the greater the increase in wasted fuel. This statement does not apply in all cases, because all scale-making properties are not alike as non-conductors of heat, consequently there are cases where that rule does not apply.

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* Chief engineer of the Canadian Casualty & Boiler Insurance Co., Toronto.

While we are deep in our scale troubles, along comes the mechanical boiler cleaner man, and he tells us that by his method of collecting funnels, circulating pipes and settling chambers the boiler is continuously cleaned, and the hard, disagreeable hot work of cleaning out is eliminated. The mechanical cleaners require some help and some of them succeed fairly well in some waters. They must be handled, they must be assisted, and the boilers opened up regularly to be sure they are performing the work, because if they are not you are liable to have a repair bill on hand.

Engineer Needs a Compound or Cleaner.

The trouble for the engineer in the smaller plant is that he wants a compound to assist him in keeping the boiler clean that is cheap. He does not care whether it is soda, in any of its many forms, which the other fellow says is no good, or whether it is purely vegetable, which the soda man says is useless, or whether it is the mechanical cleaner man's scheme, who says he has the other two beat to a frazzle. HE NEEDS A GOOD CHEAP COMPOUND. He ALSO NEEDS A BOSS OR FOREMAN OR MANAGER WHO IS ENOUGH INTERESTED IN THE MATTER TO GIVE HIM A FAIR SHOW, and help with his advice, especially as to cost. The average engineer looks upon his feed water trouble as one of his greatest difficulties on account of scale.

Feed Water Heating.

There are also other feed water troubles to be considered, especially if the plant is to show any economy. The first and greatest of these is feed water heating. For economy we must look for some means to heat the water by the cheapest heat we can capture for the purpose, which generally is exhaust steam from our engine and pump cylinders. The first heaters were of the closed type and were so arranged that the cold water was pumped through them, the steam passing through them also in small tubes or pipes. These rarely heated the water to about 140 degrees Fahrenheit, it was found that this made a material saving in fuel, and the open heater appeared, in this case the steam and water mixed and the water is heated up to 205 or 212 degrees Fahrenheit, in this case the cold water had to be fed or pumped into the heater and the hot water pumped from it to the boiler. In the early days of open heaters the first trouble was to pump such hot water. I well remember in canvassing a man who had many years' experience as a mill owner to buy an open heater. I made the statement that the water would leave the heater at 205 degrees and was then pumped into the boiler. He cooly informed me that he thought I was lying all the time but now he was sure of it, as no pump in the world would pump water; in fact, this trouble was so bad day we had trouble to get owners to look at the proposition.

Oil Troubles.

The next serious trouble in connection with open heaters was the cylinder oil carried over with the exhaust steam and pumped back into the boiler with the water, in fact this trouble was so bad that at one time it was thought open heaters were a failure, for many a bulge on a fire sheet and many leaks at riveted seams were directly traced to the presence of oil in the boiler. THIS BY THE USE OF FILTERS AND OIL SEPARATORS HAS BEEN LARGELY CURED. OUR PUMPS ARE BUILT TO HANDLE HOT WATER AND MANY OF THE OLD TIME TROUBLES CURED.

The gain in economy by heating the feed water by exhaust steam is worth an effort to reach, as every 11 degrees Fahrenheit added to the feed water means a saving of 1 per cent. in fuel, and this can be carried along until the saving reaches from 14 to 15 per cent., besides the heating of the water up to the boiling point in the heater causes some of the carbonates to precipitate in the heater where they remain and consequently assist in keeping the boiler clean. I never could take in the matter of pumping bad boiler water into a boiler and then doctor the water to purify it, why not purify it before it goes into the boiler? This can be done cheaper than treating it in the boiler. Many large plants now have water softening apparatus and the time is not far off when a means will be perfected that will enable steam plants as small as 100 h.p. to use such softness.

In case softening apparatus is used it is first necessary to analyze the water in order to determine what chemical is to be used and also the quantity to be used per 1,000 gals. A double tank, each holding one day's run of water, each fitted with a conical bottom and a sludge cock, is all that is required. One of the tanks is filled and the necessary chemicals added. This is left for 24 hours before it is used, in order that the removed solids may settle to the bottom, then while it is being used the other one is being treated. After each treatment the sludge at the bottom is washed out and the tanks used alternately. On account of the present keen competition in manufacturing, and because of the fact that we are face to face with electrical power for factory purposes, it behooves the average engineer to know these points, to understand them so well that he can correctly show them up to his employer. In this climate where factories and buildings have to be heated seven months in the year, a well equipped steam plant arranged to use exhaust steam for heating and for any manufacturing purpose that its heat is sufficient for, can be operated at a less cost than other forms of power. When electrical power is used the cost of the coal used for heating should be added to the cost for electrical power, because exhaust heating is not an added expense.

LUBRICATING PROBLEM SOLVED.

A certain manufacturer had an order for a machine that included three hollow gun metal rollers, one weighing 1,386 pounds, the other two weighing 752 pounds a piece. These rollers are heated by gas to a temperature of about 700 degrees, and it was found that any oil or grease would carbonize and cut the journals in a very short while. It was suggested that the builders of this machine write the Joseph Dixon Crucible Co. concerning the use of graphite on the rollers. This was done and proper suggestions were made for the use of Dixon's Flake Graphite to be used alone, and some months later the makers wrote the Dixon Co. that the scheme had met with perfect success. Of how the graphite was applied, the letter speaks as follows :—

"The method of applying the graphite to the journals is very simple, the channels for conveying the lubricant to the journals are cut in the boxes about ⅜" wide and ¼" deep, one on top and one at a little above and on each quarter. Besides this, a spiral groove of the same dimensions is cut for about two turns, commencing at about 1" from the other end of the box and near the bottom. These grooves are half round in section. Into the top straight groove, a ½" pipe hole is drilled and tapped, a piece of ½" pipe screwed into this with a reducing socket on the top end to 1¼" pipe, a 1¼" nipple with a 1¼" cap complete the cup. A piece of 3-16" inch round C. R. steel with one end on the journal, with the other end up near the top of the cup, complete the device. The journals take about a dessert spoon full of graphite per day to each journal, the machine attendant occasionally removing the cap from the cup, churning down a little of the graphite with the 3-16" rod."

No doubt, problems of this kind have come up in the experience of readers of this matter, and they may wish to avail themselves of this information in some future case.

PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

STEAM BOILER INSPECTION.

By James E. Noble.

Every engineer should inspect his steam boilers internally; if he does not examine them every few weeks he is not a safe man to have in charge. External inspection is also essential, for external corrosion, burned plates, etc., has caused many explosions. Of course, there is a right and a wrong way to inspect a boiler. The correct way is to crawl, creep or wiggle throughout the inside of the boiler, through the firebox, the back combustion chamber and into the smoke front. To insure a reasonable degree of comfort when inspecting, a combination suit of overalls is absolutely necessary. Mine, shown in Fig. 1, have elastic bands around the wrists and ankles. A pair of shoes with fairly long uppers form part of the outfit. A similar suit can be bought for two or three dollars, and if used only once or twice a month will last for many years, and will pay for itself a hundred times over in the comfort and cleanliness it affords you; nothing but your underclothing should be worn with this suit.

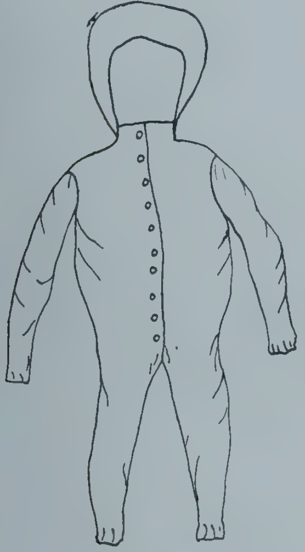


Fig. 1.—Suit for Cleaning a Boiler.

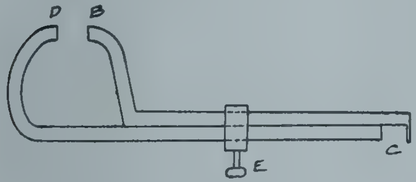


Fig. 2.—Boiler Calipers.

A handy home-made pipe and sheet calipers is shown in Fig. 2. To use this tool insert the point D through a hole in the pipe, slacken up the thumb-screw E, and lower point B against the outside of the pipe, taking care to see that the points are squarely against the metal. The thickness of the metal is shown at C, and can be measured with a steel scale, or if the maker desires, he can mark a scale on the side of the calipers.

Fig. 3 shows the test pump used to test the steam gauges once a month. It is not a home-made affair, but every steam plant should have one, as they cost but a few dollars, and a defective gauge may lead to the loss of many lives.

Fig. 4 shows a hammer, with a hatchet peen, which is bent forward at A. The point can be kept ground sharp. It is handy for digging rust or corrosion out of corners, etc., and once used in boiler inspection will never be discarded for any other hammer by the inspector.

Fig. 5 shows a home-made jack for removing the pointer from the spindle of a gauge. To use it, the notch is slipped under the hub of the pointer, or hand-piece, and the end of the screw is turned down against the end of the shaft. A few turns of the thumb-screw will force the hand loose without bending either the hand or the shaft. This often happens when attempts are made to loosen a tight hub on a gauge with a screw driver or pliers forced under the hub. I have seen steam gauges upon boilers with absolutely no water seal below the gauge. A gauge spring can and often is permanently destroyed by steam getting into it. The engineer should see that every steam gauge has the piping so arranged that there will be a water trap under it to prevent live steam reaching the spring. The reason accorded for some engineers not having traps is the frost; but where there is any danger of freezing when the boiler is not in operation some means of emptying the trap can be employed.

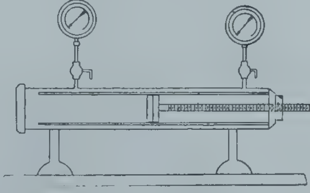


Fig. 3.—Double Cylinder Gauge Test Pump on Wooden Base.

I would not attempt to inspect a boiler unless the combustion chamber and shell was swept clean, and as much dirt as possible removed from the interior.

The bottom connection to the water column should be carefully examined. Many times I have found this connection partly closed with sediment or scale.

The blow-off pipe should be carefully examined as often as possible. Hundreds of these pipes pass through the combustion chamber with absolutely no protection from the furnace fire. When returns enter the boiler through the blow-off there is not as much danger of a burned pipe, but if no returns enter this way, and the engineer allows the pipe to fill with sediment, a rupture is very apt to occur, especially if the pipe is not covered.

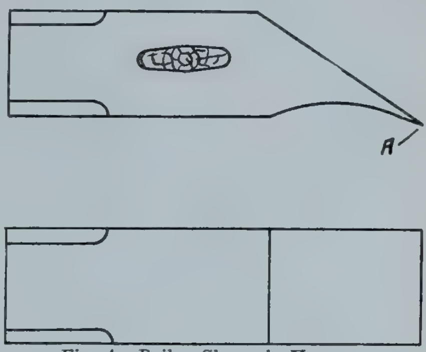


Fig. 4.—Boiler Cleaner's Hammer.

The Power House could be filled from cover to cover with boiler inspection material alone, but I trust the foregoing few words will prove a help to some of its readers.

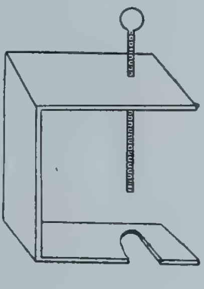


Fig. 5.—Tool for Removing Pointer of Gauge.

ENGINEER'S GREATEST TROUBLE.

By E. H. Oliver.

I believe the greatest trouble an engineer has to contend with is dirt; in some of its various forms, take an engineer of a small sized plant, say two or three hundred horse power; he has a fireman, and the two have to look after the whole plant; now it looks to me that if it were not for dirt in some shape or other they would have a comparatively easy time of it. Take the dirt that is in the feed water (even though it is put through a good heater) it gets into the boiler and stays until it is washed out, which is quite a little trouble, and that does not end it either, as that is a job which comes around as regular as pay day only a little oftener. And then look at the amount of trouble a dirty boiler sometimes causes; a bagged sheet, leaky tubes, leaky pipe joints, and sometimes a scored cylinder caused by the boiler priming through being dirty. And then again look at the fireman; how much easier life would be for him if it were not for dirt in the coal, no ashes to wheel out, no fires to clean, no clinkers to fish out of the fires, nothing to do but shovel in nice clean coal; in which case some people would envy the fireman, which I don't think they have much cause to do at the present time.

Now let us take a peep at the engineer; he has probably just got through sweeping out the engine room and wiped off the engine, everything looks nice and clean. He has been around and felt all the bearings and everything is O.K., so he picks up his trade journal to see what is new in his line; when instinct or something peculiar to the engineer tells him something is wrong and he hunts around and finds he has a hot bearing, now what do you suppose has caused it? Probably he couldn't tell you but it's more than likely that a little bit of dirt has got in some way or other, may be in the oil or some other inconceivable way, but anyhow it got there just the same. Of course I don't mean to say that all hot bearings are caused in this way, but I think a good many could be traced to this source.

Another great trouble the engineer has to contend with is to make his employer see that any improvement the engineer wishes to make is not solely for his own benefit, or to save himself a little work, but for the benefit of the whole plant, and incidentally the employer; and last, but not least, one of the greatest troubles a good engineer has, is to convince the boss that his engineer is really worth all the pay he gets and generally a little bit more.

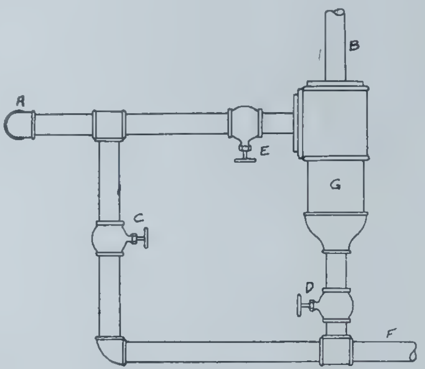
BLOW-OFF AND SKIMMER PIPING.

The sketch herewith shows a very simple and efficient blow-off and skimming piping arrangement for a return tubular steam boiler, devised and used by F. Hutchinson, engineer for Mason and Risch Piano Co., Toronto.

Elbow A leads from the bottom of the boiler, and pipe B, leads to the top of the boiler, immediately below the water line, so that with valves C and D closed, and E open, the arrangement forms the usual boiler circulating piping. Additional piping is introduced, as shown, the pipe F leading to the sewer.

In case it is desired to blow-off the boiler sediment, merely close E and open C; or if the scum must be gotten rid of, the skimming can be accomplished by closing E, and opening D; or skimming and blowing-off may be simultaneously done by closing E, and opening both C and D.

A short section of large pipe is put in the system at G to act as a sediment collector for the circulating water. Sufficient sediment collects in this chamber every three or four days to make the opening of valve D necessary for its removal.



Blow-off and Skimmer Piping.

SEA WATER CAUSED FOAMING.

At one plant where I was employed we dug a well near a river in which salt water flowed. The soil was loose-sand gravel and the well was dug 12 feet below the river level at low water. We used 8x8-inch timber cut so as to form a hexagon curb 14 feet across, each tier of curb being 1 inch smaller on each side than the one below, thus forming a beil-shaped curbing. The ends were cut to fit, and were spiked at the corners and toe-nailed at the sides. The weight of earth on the outside assisted in pushing the curb down.

We dug out about a foot below the curb all around and six men standing on the curb, each with a piece of timber, gave a few blows all together on top of the curb to drive it down.

The well worked all right until a dry spell came and our supply of fresh water for the well, which came from the hills, failed, and we were soon pumping brackish water into our boilers.

Dutch ovens were used, and when one was fired a little harder than the other that boiler would get busy passing water into the engine, and in five minutes there would be no water in the water glass. The engine, a 24x30-inch, was usually flooded to a standstill, or nearly so. When this happened we deadened the fire as quickly as possible, and after again getting the boiler filled to its proper level, it was put to work. This kind of trouble continued until the end of the summer.—D. F. Bedford in Power.

FILTRATION OF WATER SUPPLIES.

The quality of water for human consumption depends upon the polluting and purifying influences to which it has been subjected before reaching the consumer. It is well known that the general health of a community using a sewage polluted water gradually falls lower and lower and the death rate increases proportionately. Of the diseases most frequently following the use of an impure water, typhoid fever holds, at the present day, the most prominent position in the public eye. It is a curious fact, as yet unexplained, that the change from an impure water to a pure supply diminishes the sickness and death rate, not only from typhoid fever, but also from tuberculosis, pneumonia, and other serious diseases. It is also a fact that in certain cities using a sewage polluted water the death rate from typhoid fever is many times more than that for cities using a filtered water supply taken from the same source.

Generally speaking, there are two methods in use for the filtration of public water supplies: they are known as the "Slow Sand" filtration and "Mechanical" filtration. In the former type, the water filters through beds of sand and gravel at varying rates of from two to five million gallons per acre every twenty-four hours, according to the character of the water. In mechanical filtration, a preciptate is first added to the water, which is then passed through a medium of sand under pressure, the rate of filtration being many times more than in the slow sand filters.

The type of filter for any particular water must be carefully considered before adoption by a municipality, and this can only be done by a competent sanitaray engineer. When either system can be used, it resolves itself into a question of primary cost and annual maintenance. The slow sand filters cost, approximately, $30,000 per million gallons of the daily consumption and about ten per cent. of this per annum for operating; while a mechanical filter costs about one-fourth, and, if carefully operated, a high degree of efficiency as regards purification can be obtained. This is well exemplified at Chatham, Ont., where for some years filters of this latter class have been in operation, the water treated being that of the river Thames.

HYPOCHLORITE TREATMENT OF WATER.

The attention of the public, as well as health and municipal authorities, has been directed during the past few months to the purification of water by means of the addition of small, very small, quantities of hypochlorite of calcium, otherwise known as chloride of lime. We have been led to believe the process is a very simple one; indeed, so simple that a child might almost direct the treatment. It is true that in case of emergency, municipal and health authorities may, under the direction of a sanitary engineer, improvise the means for the application of the hypochlorite and thus prevent outbreaks of typhoid fever when the water is sewage polluted; but for the proper and scientific instalation, as well as for the oversight and management, expert services give the best results, and where a municipality will pay for the services of an expert, the expenditure is more than compensated for by the results obtained. These facts are clearly shown by the work and operation of what is known as the Bubbly Creek water purification plant of the Union Stock Yard and Transit Co., at Chicago, which has been in operation for nearly two years.

The following information descriptive of it is taken from the report of C. A. Jennings, chief chemist and superintendent of filtration:

First, as to the class of water. Bubbly Creek receives the sewage of some 350,000 people—about the population of the City of Montreal, and a larger population than the City of Toronto. The normal size of the creek is not given, but the bacterial results for a period of 12 months show the maximum to have been 2,350,000 bacteria per cubic centimeter (about 18 drops), while the minimum was 30,000—the average being 354.000 per cubic centimeter.

Without entering into details, it may be said that the plant consists of pumps, a canal, now part of the sedimentation system, three pairs of settling basins and mechanical filters. From these latter the treated water flows into the clear-water well and from thence it is supplied to the stock yards.

Consequent upon the close and intelligent oversight maintained, various changes have been made both in the operation of the plant and in the chemicals used in the treatment of the water. These can be learned in detail by reference to the "Engineering Record" of September 24th, 1910. At the present time, the coagulant used is sulphate of alumina, a solution of a strength of 3.3 per cent, being used. Subsequently hypochlorite solution of the strength of 1.2 per cent. is added, after which the water passes through the filters and is then ready for use.

As regards the cost of operating this particular plant, the contract guarantee called for nothing in excess of twenty dollars per million gallons, this to include cost of chemicals, labor, and power for pumping, but not depreciation charges and interest on investment. The cost of operation has averaged only $10.54 per million gallons, and a still further reduction in cost of operation will be shown, as, since the use of hypochlorite, a total reduction of some 60 per cent. has been made in respect to chemicals alone.

Too much credit cannot be given to Mr. C. A. Jennings for this practical demonstration of how water strongly polluted with sewage may be converted into a potable water of a high quality. The reporter states it was drunk by himself and his assistants in preference to the city water, and he significantly adds, "There has never been a single case of sickness or intestinal disorder caused by doing so." ,

Undoubtedly, municipalities having water supplies liable to contamination by sewage have much to learn from this interesting work and they certainly can have no excuse hereafter for serving out to the public a sewage-polluted water.

CUTTING OIL COSTS.

Oil is one of the things which seems to disappear mysteriously in a plant. In one case mentioned in Factory a new superintendent found that the oil consumption on the average was a barrel of oil, 50. gal. at 30 cents a gallon, each week, which was about twice as large as it ought to be.

Starting an investigation he found that the holes in the oil can spouts were four times as large as needed, that oil casks as delivered were not always full. that checking up was not carefully done, so that some oil which had never been delivered had been paid for and that the oil was stored in an out-of-the-way corner with nobody held responsible for its disappearance. The oils as used were not rightly adapted to their purpose and much power was wasted by having it either too thick or too thin.

Examining the machinery he found some of it oil-coated, while some of it showed signs of excessive wear for want of oil. As the plant was too small to put a special man on the oiling proposition, he had tests made to find out which oils were best adapted for the different machines, and adopted, instead of two kinds of oil. which had before been used. six kinds and two good kinds of grease, a soft grease for slowly-moving bearings and a hard grease for rapidly-running bearings. The six kinds of oil used were cylinder oil, heavy engine oil for engine and other heavy bearings, light spindle oils for the spinning department, dynamo oil for motors, a medium heavy oil for general machinery, and a stainless oil for the looms.

A careful oil record was then started of all oils which came into the plant, when they were received, the inspection of barrels, where they were put in the storehouse, and what departments the oils should be used in. A man was then placed in charge of the oil house and made responsible for issuing the oils. After careful experiment, the amount of oil to be used each week and to whom it should be issued was put in the oil record book. In this way the oiling was brought down to a scientific basis and the oiling itself was done by people of good judgement. instead of by haphazard boys. After charging up all cost of the new system and the labor on the oil account, it was found that a saving of $300 a year had been made.

WILLIAM PERRY.

William Perry, hydraulic engineer, Montreal, has arranged with the International Steam Pump Co., New York, for the sale of the Knowles and Dean Steam Pump Company's machinery in Canada. The International Steam Pump Co. are manufacturers of the Worthington, Blake & Knowles and Deane Steam Pumps. The Knowles Steam Pumps are identical with the Blake. Mr. Blake was connected with the building of the fire engine that took the gold medal in London in 1851. He installed the first pumping plant for Peterboro, Stratford, Iroquois, Ont., St. Hyacinthe, Que., and City of St. Albans, Vermont; fire protection plant for the Edwardsburg Starch Co., North Pacific Lumber Co., Barnet, B.C., C. P. R., Winnipeg, Bell Telephone Bldg., Montreal, and others; compressed air lifts for the Montreal Brewing Co., Warden King & Son, Gunn & Langlois, Henry Gatehouse, Montreal, Phillipsburg Quarry Co., Phillipsburg, Que.; and steam pumping plant for the Royal Victoria Hospital (pump down the well 425 feet.) For 31 years he was manager of the pump department of R. H. Buchanan, Montreal. Mr. Perry has had 59 years' experience in the pumping machinery line and is actively engaged in that line with offices at 848 Maplewood Ave., Montreal.

A concise way of stating the value of exhaust steam is that every six pounds of it is worth as much as one pound of coal, plus fireman's wages, plus interest and depreciation on boiler plant, plus six pounds of pure boiler-feed water. That is, provided you want the steam for heating, drying or similar purposes.

Correspondence

BOILER FEED TROUBLE.

I am using a pair of return tubular boilers, have to each boiler a feed connection direct, and one from heater which is nearly altogether used; water from an 800 ft. well, very strong in sulphur. I use sal-soda to prevent scale. Every little while one of the nipples between the check valve and the boiler goes out, being badly pitted. I suppose I could help matters considerably by putting in a vertical check, but I fear that the water must be very hard on the boilers, and the pitting is of such a nature that an inspection will not show it up until too much damage is done.—Engineer-in-charge.

LUBRICATION.

I would like to know if a force-fed pump for oiling engine cylinders can be made to give equally good results as a sight feeder lubricator with less oil? The manufacturer claims that the oil can be fed in more quickly in smaller quantities, and therefore lubricate as efficiently with less quantity of oil.—Subscriber.

ENGINEER'S CERTIFICATE.

When can I obtain an Engineer's Certificate? Can I get it at any time?—Ontario Subscriber.

You can write for it at any time. Address W. C. McGhie, Chairman Stationary Engineers' Board, Parliament Buildings, Toronto, who will give you full information and application forms.—Editor.

REMOVING RUBBER GASKETS.

When a large main, say a 6-inch steam main, is well anchored in place and refuses to "give" any and it is desired to put in a rubber gasket in a flange along the line, how can one proceed to do it in an easy and mechanical manner without tearing things all to pieces? Please answer in the next number of the paper.

—M. L.

We should have the new gasket already cut before we started on the job. It could be marked out on a piece of rubber and cut with a knife, or the rubber laid on half of a flange, and the gasket cut with a machinist's hammer or the gasket cut with a gasket and washer cutter. (A new device for this purpose is being marketed by J. A. Rose, Hastings, Nebraska.) We would then proceed to block the steam for about three quarters of an hour and then take out the bolts of the flange. Then take an old saw and start sawing downward on the gasket, that is in the flange, and which is to be removed. When you are about half way through, and before the force of the main tending to make the flange comes together, gets in its action, drive a small cold chisel into the top of the flange in such a manner that it will hold the distance that you have gained in sawing out the old rubber gasket. When the saw has passed all the way down you can try to clean the faces of the flange by using some emery paper on them, but this will be rather a difficult matter from the lack of room. The new gasket can be pulled to its place by fastening a string in one side of it and gradually drawing it to its place, after which the flange may be bolted up again. Do not pull any one bolt down tight first but gradually tighten on them all. —D.H.C.

BOILER STAY QUESTION.

On page 44, October issue of The Power House, the writer notes the question asked by "Boiler Stay."

"Boiler Stay" has, however, omitted to state if the end-to-end stays are screwed into the respective heads; the assumption being that they do not.

The load on the body of the end-to-end stays will be the number of square inches times the working pressure, or in the case mentioned, the load will be 100x135 equals 13,500 pounds. This practically answers question (a).

"Boiler Stay" says that when the outer nuts are screwed up the end-to-end stay is under tension. This assumption is wrong for the inner nuts should be the first tightened up, and this will produce, if it produces anything, compression in place of tension.

In boiler construction the nuts, inside and outside of the head on end-to-end stays, should not be tightened so as to produce a stress of any magnitude. If "Boiler Stay" will tighten the inner nuts first, and not to the extent to "bow" the end-to-end stay, the work will be done proper; the end-to-end stay will not be under tension in the least.

Then tighten up the outer nuts, and they need not be pulled up beyond reason—that is to say, do not use a long wrench and tighten the nuts as if an attempt was being made to strip the threads. If the nuts are tightened up proper, the end-to-end stay between the nuts will have little or no tension—so little that it need not be considered.—H. S. Jeffrey.

2.051X7000 equals 14357 lb. equals safe working stress in a stay with double nuts, the area of which is 2.051 sq. in. The stress in the body of the stay equals 135X100 equals 13500 lb. The stress on the portion of the rod between the nuts will still be 14200 lb unless there is unequal expansion between the nuts, rod and boiler head. Should the rod expand enough due the heat and stress to relieve the extra pressure caused by tightening up the nuts, then the stress will be equal the entire length of the rod. The stay is of ample size to support 100 sq. in. of surface carrying 135 lb. of steam per sq. in.—N. R. Watkins.

PISTON TRAVEL AND PUMPS.

I would be pleased to have an explanation from some of the readers of The Power House of the term 100 ft. piston travel as applied to pumps with examples, (1) a single action pump; (2) a single cylinder double action pump; (3) a double action duplex pump.—B.C. Reader.

FRICTION LOSSES.

Scientific tests by prominent authorities have proven that friction losses are much reduced and the carrying capacity of the bearings greatly increased when the lubricant contains the correct proportions of Dixon's pure flake lubricating graphite, and these tests are proven by actual experiences.

Sometime ago Professor W. F. M. Goss, Dean of the College of Engineering, University of Illinois, made some tests with the Dixon pure flake lubricating graphite on ball bearings. As a result of these tests, Professor Goss says in part that the following conclusions may be drawn:

"A combination of graphite and lard oil makes up a lubricating mixture which, when applied to ball bearings, will accomplish everything which lard oil alone will do and which at the same time will give a lower frictional resistance of the bearing and permit a large increase in the load which it may be made to carry.

"An oil as light as kerosene, when intermixed with graphite, will be converted into an effective lubricant for ball bearings when operated under light or medium heavy pressure.

"Even so viscous a lubricant as vaseline will better perform a given service in the lubrication of ball bearings when supplemented by small amounts of graphite. The bearing to which the mixture is applied will work with less frictional resistance and will carry a heavier load than when vaseline alone is used.

"The admixture of graphite with either a liquid or viscous lubricant. serves both to reduce the friction and to increase the possible load which a bearing thus lubricated can be made to carry."

The Joseph Dixon Crucible Co. of Jersey City, N.J., have a record of Professor Goss' extensive tests with graphite as a lubricant, published in pamphlet form under the title of "A Study in Graphite," which is sent free on request.

ELECTRICITY FOR STATIONARY ENGINEERS

HYDRO-ELECTRIC POWER.

The celebration at Berlin on October 11 marked the beginning of Government distribution in Ontario. Among those present were: Sir James Whitney, Hon. A. Beck, chairman of the Hydro-Electric Power Commission; General Green, president of the Ontario Power Co.; F. H. McGuigan, who had the construction contract, and P. W. Sothman, chief engineer of the Hydro-Electric Commission.

At the "turning on of the Niagara power" were a number of exhibits of electrical machinery and supplies, the companies exhibiting being: Chapman Double Ball Bearing Co., Canadian General Electric Co., Factory Products Co., G. C. Royce, Death & Watson, Holman Electric Sign Co., Federal Engineering & Supply Co., A. H. W. Joiner, Simplex Co., and Northern Electric & Mfg. Co., Toronto; Onward Mfg. Co., Berlin; and Canadian Tungsten Lamp Co., and Canadian Westinghouse Co., Hamilton.

The following municipalities have contracted for power in western Ontario, or have passed by-laws favorable to making contracts: Windsor, 15,000; Toronto, 10,000; London, 5,000; Guelph, 2,500; St. Thomas, 1,500; Woodstock, 1,200; Galt, 1,200; Hamilton, Stratford and Berlin, each 1,000; Waterloo, 685; Preston, 600; St. Mary's, Paris, Ingersoll, Brampton and Tillsonburg, each 500; Hespeler, 400; Mitchell and Seaforth, 300; New Hamburg, 250; Norwich, 150, and Sebringville, 100.

SAVING ELECTRICITY.

Tungsten lamps are coming to the front because they save electricity. In appearance, their only difference from the ordinary carbon filament incandescent lamp is that the filament is constructed of tungsten instead of carbon. But in actual use, it has been proved that they use only about one-third as much current as a carbon lamp to produce a light of the same illuminating power. True, their first cost is greater (approximately three times as much), but this is counterbalanced by the saving in current effected. They have one weak point, however. That is the ease with which the delicate tungsten filament is broken. On this account great care has to be exercised in installing them, and it is for this reason, too, that they cannot be economically used as portable lamps. Yet, when carefully handled, they have a long lease of life. In England, where they are used much more extensively than here, it is quite common for them to last 3,000 hours, and one instance is on record where a tungsten lamp burned continuously for over 15,000 hours. Even when allowance is made for more frequent breakage, the tungsten lamp shows a saving over the carbon of about fifty per cent. That is an economy not to be despised and points to the much greater use for stationary lighting purposes.

TORQUE OF A MOTOR.

When dealing with electric motors one of the elements which determines its ability to do work is called its Torque. This word comes from the Latin, and means "to twist."

The measurement of the torque of a motor is, in one sense, an arbitrary or fixed standard, and may be illustrated in this way: Suppose a drum exactly two feet in diameter to be keyed on the armature shaft of a motor, and on this drum a cable or rope is wound, and that its free end hangs down a well, the torque of the motor is the weight it can pull up. The essential point about this view of the torque is that it is always calculated for a drum 2 ft. diameter or 1 ft. radius. That size is arbitrary and fixed, very much as the 85 per cent. boiler pressure is the arbitrary ratio selected by the Master Mechanics' Association for finding the mean effective pressure in the cylinders of a locomotive.

If torque is always calculated as the pull on a rope wound on a 2-ft. pulley, it is obvious that if instead of a pulley of this size we had a wheel 4 ft. diameter the torque of the motor would exert less force at the circumference of such a wheel than it did on the 2-ft. drum. If the torque of the motor was 500 lbs., the force between wheel and rail with 4-ft. wheel, would only be 250 lbs. The larger the wheel the less the force produced by any given torque. This is practically the same with a locomotive, the larger the driving wheel the less the tractive effort, where the other factors remain the same.

The ability to do work introduces the element of time, and if our motor with 2-ft. drum has a torque of 500 lbs. and is revolved at the rate of a little over 105 revolutions a minute, the weight will be pulled up out of the well at the rate of 660 ft. a minute. Thus the weight of 500 lbs. will be raised 660 ft. a minute and 330,000 foot-pounds of work will be done, that is 10 horsepower. With the 4-ft. wheel treated as a pulley and supposed to haul up the weight, the same number of revolutions a minute will pull a weight of 250 lbs. up close to 1,320 ft. in one minute, and that will give the same number of foot-pounds of work and the same horsepower.

If, however, the motor with 500-lbs. torque mounted on 4-ft. wheels is run twice as fast, that is, just over 210 revolutions a minute, we find that the lighter weight of 250 lbs. comes up at the rate of 2,640 ft. a minute, and that gives 660,000 foot-pounds of work or 20 horse-power. When we come to consider power, which is the rate at which work is done, we find that with a given torque, power is proportional to speed, and conversely with given speed, power is proportional to torque. Torque is the strain on a rope wound on a drum 2 ft. diameter. Work is the product of this strain, in pounds, by the distance through which it acts, and power is the number of foot-pounds multiplied by the time it is in operation. Time so used is usually expressed in minutes. One horse-power is an arbitrary unit in which 33,000 lbs. are moved through one foot of space in one minute of time. Any exact equivalent of this is also a horse power, such as 275 lbs., raised 1 ft. in half a minute.—Railway and Locomotive Engineering.

FLYWHEELS ON ELECTRIC MOTORS.

But few engineers realize fully the benefits to be derived from the use of flywheels on motors which are subjected to fluctuating loads. The writer recently had this fact brought home to him in a very forcible manner. An induction motor of 25 h.p. was installed in a concrete tile factory to operate a tile press, concrete mixer and pump. The regular speed of the tile machine is seven tiles per minute. The period of each operation which requires the maximum amount of power is when the runner is being lifted out of the tile. This period is of about three seconds duration and gives the motor a momentary overload of about 50 per cent.

This not only tried the motor severely, but noticeably affected the regulation at the power plant and on the lighting lines. As the motor was overloaded such a small portion of the time it did not exceed the allowable temperature rise and it was quite a problem to decide upon a remedy. Finally it was decided to try a flywheel upon the motor and one was procured from the manufacturer of the motor which was twenty-four inches in diameter, weighed four hundred pounds, and was machined all over and perfectly balanced.

Since this flywheel was placed upon the motor the fluctuation of primary current due to this verying load has been less than one ampere, whereas, before it was installed it varied from five to ten amperes, depending upon the size of tile they were making. This experience has been a lesson to the writer. Hereafter when an electric drive is contempalted, where the load is of such a fluctuating nature as to prove trying on either the motor or the regulation of the circuit upon which it operates, a flywheel type of motor will be employed. —C. L. Clary in National Engineer.

PREVENTION OF SYPHONING OF TRANSFORMER OIL.

J. C. Dow.

Oil may be syphoned out of a transformer case by the leads in two ways—by the insulation, or by the capillary action of the oil in the spaces between the wires of the flexible leads. To prevent the former all that is necessary is to remove the insulation for an inch or two above the oil surface within the case. To prevent the second action the spaces between the wires must be filled with some oil repellant. This can be accomplished by using a solid lead or by filling the flexible lead with solder, but neither method prevents the oil from creeping along the surface and both require the lead to be non-flexible at least for part of its length.

It is possible, however, to fill a short section of the cable above the oil in the case with glycerine, thus preventing the oil from syphoning and still leaving the cable flexible. The cable must first be stripped of its insulation for two or three inches or more, depending on its size, the oil thoroughly removed from that section of the cable and pure gylcerine run in. The oil can be removed with gasoline and this must be done thoroughly all through that section of the cable. The slight residue left from the evaporation of the gasoline will prevent the gylcerine from working into the cable, but this residue can be removed with alcohol. This removal must also be thorough. The alcohol should then be removed before drying by means of water, and while the cable is still wet, the gylcerine is worked in. The gylcerine should be as pure as possible, but it may be necessary at first to use a solution of gylcerine in water to make it enter the cable. Gylcerine is an oil repellant, but is an absorber of moisture, and hence this method should be used with caution on high-voltage transformers.—Electrical Journal.

NEWS OF SOCIETIES.

Mr. Coates, of the Dunham Trap Co., Toronto, gave a paper on "Vacuum Heating" before No. 1 Lodge, C.A.S.E., Toronto, on October 21.

On November 9, Prof. Angus gave a lecture on "Boilers and Combustion," before No. 1 Lodge, C.A.S.E., Toronto. The meeting was held in the Mechanical Engineering Building of Toronto University, after which the laboratories were thrown open for inspection.

The annual banquet of the Toronto Lodge, C.A.S.E. will be held in the Walker House, Toronto, on December 2, W. C. McGhie is chairman of the banquet committee and a good menu and program will be provided.

An interesting program of lectures has been arranged for the winter months by the entertainment committee of Toronto Lodge, C.A.S.E. as follows:

Dec. 16—Electrical Illumination.

Jan. 20—Chemistry of Coal by Prof. Bain.

Feb. 17—Internal Combustion Engines by Geo. Henderson.

Mar. 17—Power Transmission by Mr. Archer.

The educational committee consists of A. H. Kirby, chairman; J. C. Tweedale, secretary; A. M. Wickens, J. W. Marr, J. K. Biggar, M. H. Kerr and T. D. McGhie.

The Engineers' Club, of Toronto, at its regular meeting November 10, discussed the by-laws to govern the Club in future. The Club will consist of 800 members. Provision is made for charter members who do not wish to avail themselves of the social privileges. For these the rate will be the same as for the old club.

DEEMING POWER PUMPS.

A handsomely bound copy of the Deeming Power Pump catalogue has been received from Darling Bros., Montreal. It consists of 190 pages printed on coated paper and in two colors. A fund of valuable information is included in the volume, the concluding 20 pages consisting of rules, etc.. making the catalogue a particularly valuable book of reference. Prices of pumps are also included and applications of same.

FOR THE DECEMBER ISSUE.

In the December issue will appear the second article on Superheated Steam by H. G. Bertram, and the second article on the Design and Management of Electric Power Plants, by H. Baron. Other articles by John C. Tweedale, James E. Noble, R. McLaren, G. J. Parry, Richard Bell and others, will appear, making the December issue a particularly valuable

THERMAL STORAGE.

A pamphlet of 30 pages from F. A. Yerbury, vice-president and managing director of the Canadian Boving Co., Toronto, describes Halpin's Thermal Storage System. The information in the pamphlet is intended to enable those interested in the subject to understand its principles and methods of application. The advantages of the system are clearly set out, and have, as will be seen, been confined by results obtained in actual working.

ROLLER CHAIN TRANSMISSION.

Roller chain used for transmitting power has been known to stand up at a speed of 2,000 feet per minute, and to transmit 25 horsepower at 1250 feet per minute. Speeds of 1,000 feet per minute and under, however, give better satisfaction. Block chain is best adapted to slower speeds, about 700 feet per minute and under. Other conditions being the same, it is preferable to keep the speed high and the chain pull low.

BRUSH ELECTRICAL ENG. CO.

The Brush Electrical Engineering Co., of London and Loughborough, one of the leading engineering concerns in England, has established a branch through the Canada Ford Co., Canadian Express Building, Montreal, who will handle all their manufactures, including steam turbines, high speed engines, electrical generators, motors, transformers, electric lamp, fans and other apparatus, steam and electric locomotive, and street car and underground rolling stock.

PERSONAL.

Kenneth Seaver has been appointed Chief Engineer of the Harbison-Walker Refractories Co., Pittsburg, Pa.

Robert F. Harrison, sales manager for F. Reddaway & Co., camel hair belting, Montreal, leaves this month on a business and pleasure trip to the Old Country. He will be absent a couple of months, spending Xmas at his home in England.

Chas. Guest Norris, of Manchester, Eng., is now on a visit to Canada, in connection with the Lea Recorder, for measuring the flow of liquids. Drummond, McCall & Co., Victoria Sq., Montreal, are the Canadian agents.

REFRIGERATION DEPARTMENT

INDICATING AMMONIA COMPRESSOR.*

By W. Everett Parsons.

There is no better means of ascertaining whether or not the various parts of a compressor are performing their functions properly than to use an indicator, such as is used for steam engines. It will not do to be satisfied with a mere casual examination of an indicator diagram, for careful study is necessary to obtain the best results, and to know when these are shown by the indicator. A regular record of the revolutions of the machine should be kept, so that a gradual increase of speed will be noticed.

Diagrams shown in Fig. 1 were taken from a horizontal, double-acting compressor that was provided with a water jacket. The engineer was in favor of the wet compression system, and made no use of the water jacket. He also protested strongly that his compressor was all right, and that he did not want any indicator diagram on it. Diagrams No. 1 were then taken, and the engineer was surprised when he saw that the discharge valve at the head end required a great deal of pressure to open it, and that it did not then open wide nor close promptly. It was also demonstrated that he was admitting too much liquid ammonia to his compressor. Diagrams No. 2, Fig. 1, were taken after the freezing back had been reduced until the discharge became hot.

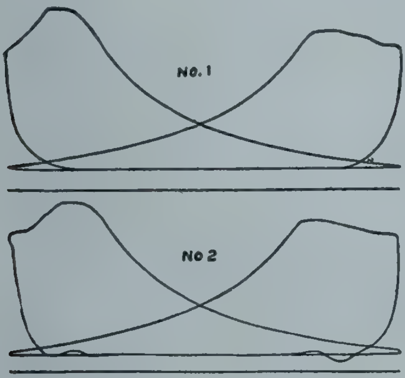


Fig. 1.—Diagrams not Using Water Jacket.

When diagrams No. 1 were taken, the loss due to clearance was about 17 per cent., while when No. 2 was taken, it had been reduced to 10 per cent. The indicator showed also that the high-pressure ammonia gauge was indicating about 25 per cent. higher than the actual pressure. Apparently, the condensing pressure was too high, so that the engineer was spending a large sum of money for additional condensers, when it would have cost him less to have had his gauge tested. The diagrams in Fig. 2 were taken from a double-acting, vertical compressor that was being used for ice making. When diagrams No. 3 were taken there was so much liquid ammonia entering the cylinders that the discharge was quite cold. The engineer stated that he considered it proper to circulate as much liquid ammonia as possible, but he confided the fact that he did not freeze back quite as hard as did his predecessor. Diagrams No. 4 were taken after the freezing back had been reduced until the discharge was hot, and in this way the engineer was convinced that the refrigerating work done is not always in direct proportion to the intensity of the freezing back. These diagrams also show that one of the suction valves was leading badly. Instances of this kind show clearly that compressors should be frequently indicated, and to effect this, manufacturers should furnish their compressors with means for attaching an indicator.

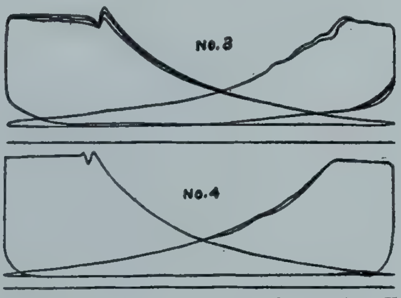


Fig. 2.—Diagrams for Double Acting Vertical Compressor.

Compressor diagrams are more difficult to read than diagrams from a steam engine, but an engineer will be amply repaid for any studying that he may do in order to enable him to properly analyze the diagrams of his compressor. Pressure gauges are liable to error, and should be frequently tested. Thermometers should be placed in the suction and discharge pipes of the compressor, in order to get the efficiency of the compressor, as this can not be told from the indicator diagram alone. In interpreting a diagram, the adiabatic curve of compression should always be drawn.

FIRST AID TO THE INJURED.

Several recent accidents in ice and refrigerating plants point to the advisability of adopting precautionary methods to prevent loss of life from the dangerous ammonia fumes liberated. All employees, especially engineers, around a plant using ammonia, should be acquainted with simple means to counteract effect of ammonia fumes, and prevent loss of life. There are several simple remedies. Common vinegar, or better still, a solution of acetic acid will counteract the effect of ammonia inhaled, and will, in nearly every case, unless the victim is practically lifeless, revive him. A few years ago I witnessed a demonstration of the value of acetic acid for this purpose, and the facts brought out should be known to every one connected with ice or refrigerating machinery. The ammonia fumes liberated in an accident in the plant overcame several of the employees, but one of the men especially was so badly injured that his throat was burned, the membrane apparently wholly destroyed by the action of the ammonia, and all thought his chances of recovery very slim indeed. Some one suggested the application of acetic acid. A strong solution of the acid was procured, and a half tumbler poured down the throat of the unconscious victim. He was soon revived, and to-day is as live and well as the best ones.

Regardless of the condition of the plant, and the reliability of the machinery, accidents are likely to occur at any time, because the action of gases confined is always uncertain, and too much pressure means a release. Under such circumstances, therefore, it is a wise policy to anticipate accidents of this nature, and provide means to save life and prevent as much suffering as possible. In ordinary cases, vinegar may be found, as stated, to overcome the effects of ammonia, and a supply should be convenient at all times. But to properly provide for the danger, other medical supplies should be kept on hand, such as arnica, adhesive plaster, etc.—J. G. H. in Ice.

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* Abstract of paper read before the American Society of Refrigerating Engineers.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. III NOVEMBER, 1910 No. 11

ENGINEERS' CERTIFICATES.

Our editorial on "Engineers' Certificates" in the September issue seems to have struck a popular chord among stationary engineers, generally, from coast to coast, if one can judge by the voluminous correspondence that has been received by the editor during the past two months. In fact "Engineers' Certificates" is a very live question and the viewpoints of the engineers must be made known in some way. The publication of all letters we have received from British Columbia, Alberta, Ontario, etc., however, would fill the paper to the exclusion of all other engineers. Canada is not the only country where the engineers' license law is under discussion. For years the engineers in the various states of United States have been discussing engineers' certificates and many opinions have been expressed and plans suggested for carrying out regulations effectively. This same situation has arisen in the various Canadian provinces and the solution is well expressed by an extract from a letter from W. G. Walters, "The fault does not lie with the examiners. The situation will not be improved until all the engineers unite, agree upon what they want, and make presentation to their respective governments."

Complaints frequently reach the desk of the editor of The Power House regarding the non-enforcement of laws in different provinces, the majority probably being from Ontario. With the idea of dealing with these and enforcing the act, power was given the Ontario Engineers' Board to enforce the act and prosecute any violation of same. Any engineer who has any complaint whatever to make regarding certificates, non-enforcement of the law, etc., will receive courteous treatment by addressing a letter to, or calling personally on W. C. McGhie, chairman of the Stationary Engineers' Board, Parliament Buildings, Toronto. The Ontario Board consists of three competent, practical engineers who are always willing to cooperate with engineers in carrying out the spirit of the act.

It rests with the engineers to make the examinations worth while and by united action the various governments would no doubt see that a uniform law is advisable. The tendency in the western provinces is to make the regulations more strict and raise the standard of engineers. The graded certificates assist in doing this. Some engineers, though they are comparatively few, argue against graded certificates for the reason that all the good jobs will be put in the hands of a few. The object, however, is to award a proper certificate to the one who can operate a 5,000 h.p. plant or a 50 h.p. plant. The majority of engineers are calling for graded certificates provided they are issued upon practical common sense lines.

The question of graded certificates has been discussed at various engineers' meetings and at the annual conventions of the C.A.S.E. The reasons given for grading certificates is sufficient from the engineers' viewpoint as well as the manufacturers. At present in Ontario if a proprietor wishes to hire an engineer he cannot tell from the certificate in what line of work the engineer is proficient, whether he has operated certain engines with slide, Corliss or Meyers valve, what class of boilers, etc. If these were mentioned in the certificate with the capacity of the plant it would simplify matters not only in Ontario but in all provinces. This would be one manner of grading and would be a recommendation to an employer; would show him in what line the engineer is proficient, and be a basis for wages. The engineer who is the best informed and has had the widest experience is, no doubt, entitled to more remuneration than the man who neglects his reading studying, discussing questions with brother engineers, etc., and has had no more experience than a very small plant.

Engineers are invited to present their views to The Power House as concisely as possible. The ideas of various engineers will be published in the December issue, along with extracts from the many long letters already received. By exchanging ideas it may be possible to agree on a basis for graded certificates, acceptable to engineers generally and to the governments.

◆

BOILER TUBES AND BOILER EXPLOSIONS.

At the twenty-second annual convention of the American Boiler Manufacturers' Association, held in Chicago, Charles S. Blake, secretary of the Hartford Steam Boiler Inspection and Insurance Co., stated, during a discussion on boiler explosions, that he thought the responsibility for explosions should be shared between boiler manufacturers, engineers and owners. He stated that the manufacturers of tubes do not seem to be keeping up with the progress made by the manufacturers of other material entering into boiler construction. Higher pressures are being carried to-day than ever before, and the tubes have not kept pace with the march of improvement. Twenty-five years ago the average pressures ran from 80 to 100 pounds, and the tubes in use at that time were identical in thickness, except in specific instances, with those in use to-day for pressures of 150 to 175 pounds, and the average quality has not improved, so that the standard commercial tube of to-day is no better than, if as good as, the tube of those days. Tubes should be stamped so that their source of origin could be located and the responsibility laid where it belongs when a casualty occurs through tube ruptures due to defect in manufacture. Tube failures are woefully common. Theoretically, a tube will stand a greater internal pressure than external, but as a matter of practice a tube which is subjected to internal pressure more commonly fails than in the tube subjected to external pressure. If the tube is defective in weld.

with external pressure the tendency is to close the opening; with internal pressure the tendency is to open it. He thought the great trouble with tubes was not so much in the material as in the imperfect welding.

Mr. Blake's remarks are evidently based on reports of his company's inspectors, and, if correct, tube manufacturers should take steps to bring the quality of the tubes up to modern requirements; to protect their reputation, boiler manufacturers should investigate fully Mr. Blake's assertions; and the Governments should take the necessary steps to guard against boiler explosions from this source.

◆

WATCH THE LITTLE LEAKS.

A drop of water may seem very little, but when these drops are multiplied, it means a great deal. And when the water is at a high temperature dropping from a boiler, it represents so much coal, which can be easily put down in dollars and cents.

A well-known Ontario boiler inspector recently called at a power plant. He noticed that there was a constant drop of water from a rivet hole, and on inquiry found that the water had been dropping away for some time.

In order to impress upon the engineer that little things added together amount to a great deal, he measured the loss of water for a period of time, taking the temperature, etc. Allowing the proper amount of coal to heat the water per pound, he found that the dropping water represented a fuel loss in actual cash of $14.56 per year.

Other sources of loss which can be guarded against are due to soot not being cleaned regularly or properly from the boiler tubes, or to oil not being separated from steam used for steam heating. Oil on the coils or radiators prevents the passage of heat, no matter how thin the film.

Recently the United States navy carried on a competitive test between warships, which resulted in the saving of $1,000,000 in the navy in one year's consumption of coal and lubricating oil. The results of the test is suggestive of possible economies which can be accomplished in the power plants if engineers will look for the little leaks that run away with the units of heat, fuel and money.

◆

PROPER LUBRICATION.

On October 20 fire broke out in the power plant of the Renfrew Electric Power Co., Renfrew, situated on the Bonnechere river, totally destroying the building and machinery. The fire, it is said, started from a hot box. Accidents will happen in the best regulated power plants, but with the oiling systems at present on the market hot boxes should be of rare occurence.

This illustration, which shows the possible disastrous results attending a hot box, is used to introduce the subject of lubrication. Engineers should realize that the lubrication of all bearings should be given every attention, otherwise disastrous results will follow. This does not mean that oil should be wasted by pouring it on the bearings. Lubrication must be done intelligently and the engineers who are alive to economies that can be practised in a power plant can lubricate the bearings in the power plant and factory or mill satisfactorily without any waste whatever.

One of the points to look for in lubrication of bearings is the hole through which oil feeds. It may be small and be clogged up, thus causing excessive wear to bearing, and perhaps a hot box. On the other hand, it may be too large and allow an excessive supply of oil to run through the bearing. One firm found the latter to be the case, and attached cups to all bearings. The oil that was saved was used on a tapping machine, resulting in an annual saving of several hundred dollars. It pays to look after lubrication.

◆

THE RECIPE BOOK.

The so-called "Coslettising" process for producing a rust-proof finish on iron is referred to in a recent issue of the Brass World. A rust-proofing process for iron and steel has recently been tried which consists in boiling the iron or steel article to be treated in a solution of 1 gallon of water, 4 ounces of phosphoric acid and 1 ounce of iron filings. By this means a black coating is produced on the iron or steel, which protects it from atmospheric and other corrosive influences. As far as the protection of the coating against corrosion is concerned, it is stated that a piece of steel treated by the process and immersed in salt water for nearly a year has resisted its attacks, so that it is practically free from corrosion, while a similar piece untreated has become badly rusted.

* * *

The English Admiralty specification for phosphor-bronze of great strength is, according to the Brass World, as follows: copper, 90 per cent.; tin, 9.7 per cent., and phosphorus, 0.3 per cent.

* * *

In a series of tests conducted by Italian engineers to ascertain the hardness of copper, tin and lead bronzes it was found that the bronzes high in tin were too hard for use as bearings and the conclusions derived were that only those containing 10 per cent. or less were suitable for that purpose.

* * *

In case of low water, cover the fire with wet ashes, or with green fuel if wet ashes are not available, and close the fire and ashpit doors. Do not touch the safety valve. Do not turn on the feed water under any circumstances. Let the steam outlets remain as they are until the boiler has been cooled off and examine to determine what damage has been done.

THIS love of one's work is at the root of all success. The proportion of successes to failures in business life is in a very decided minority, and if we reckon the partial failures and the milk-and-water successes, the ratio dwindles. Success to a marked degree can only be obtained by the man who is really in love with his work. It is not sufficient to be content or fairly well satisfied with the returns of one's work, or to make just enough effort to keep out of trouble. Big dividends will never be made or big businesses built up if one regards work as a necessary evil, something to be endured and forgotten at the earliest possible moment or when the shutters are down. Show me the man who is really in love with his work, his business, his profession—his *job*—and you will point to the man who is bound to rise to success by reason of his enthusiasm, his vitality, his imagination, and his breadth.—*George H. Frost,* in the *Organizer*.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must
Have New and Interesting Features — No Write-Ups Can be Used.

VULCAN SOOT CLEANER.

The Vulcan Soot Cleaner is designed to remove soot from the heating surface of steam boilers. It operates while smoke box doors are cold, preventing cold air coming in contact with the warm boiler.

The Vulcan Soot Cleaner has been manufactured in the United States for the past eight years and is now being manufactured in Canada by the Vulcan Tube Cleaning Co., with head office and works at 204 St. James St., Montreal. These machines have been installed and are doing satisfactory work for the G.T.R., Standard Shirt Co., N. K. Fairbank Co., Dominion Textile Co., National Breweries Corporation, Montreal Carriage Leather Co., Montreal Biscuit Co., Montreal Cotton Co.; in their Valleyfield Works, Dominion Cartridge Co.; in Brownsburg, P.Q., MacDonald Mfg. Co., etc There are 5,000 Vulcan Soot Cleaners in use and recently the Commonwealth Edison Co., Chicago, placed an order for 200 water-tube cleaners, necessitating an expenditure of $50 000.

As applied on water tube boilers such as the Babcock & Wilcox type, the connections consist of a stationary system of piping which branches from a 2-inch main steam line and enters the boiler from one side at strategic points. Each branch, which supplies several of the entering pipes, is controlled by one valve. The pipes are arranged so that every square foot of heating surface is covered.

The Vulcan system is also applicable to fuel economizers and to Manning and Heine boilers.

As applied to the rear end of a return tubular boiler a blast of dry steam is thrown into each tube and blows with the draft while the smoke box doors remain closed.

The blower arm is fitted with a series of nozzles and swings across the rear boiler head, blowing the tubes in rows on radial lines. When not in use this blower arm lies imbedded deeply in a recess in the wall.

TYPE "K" IRON BODY GATE VALVES.

The development of the gate valve had reached a point where it seemed that further improvement—while not considered impossible, for the defects in present types are well-known—was not thought to be probable, until, recognizing the great possibilities of producing a modern and up-to-date gate valve, Jenkins Bros., Limited, Montreal, decided to place upon the market, their Type "K" Iron Body Gate Valves.

Careful study was made of the defects in both the solid wedge and split wedge gate valves, and finally, a design was evolved combining all the good features of both designs, producing an excellent design.

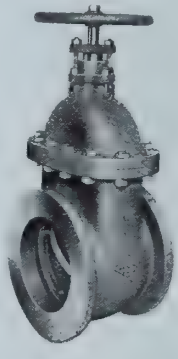


Fig. 1.—

The short valve body, taper seats and general design of the solid wedge type were retained (See Fig. 1) but the solid wedge itself was discarded as altogether unsuitable. The old style split or double wedges were also found to be unsatisfactory, owing to the crude wedging device, actuated by a wedge between the discs coming into contact against a lug in the bottom of the valve body, thereby forcing the discs to their seats. This wedge when the valve is inverted, will cause the discs to jam before the valve is closed and this type of wedge was discarded as entirely unsatisfactory.

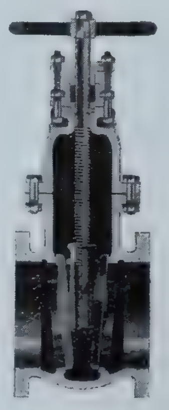


Fig. 2.—

The solution of the problem was found in the closing mechanism used in type "K" valves (See Fig. 2). This consists of two discs carried on a spindle-nut, so constructed as to act as a wedge at the point of closing and having a ball and socket bearing between the spindle-nut and discs, imparting a rocking motion to the discs—allowing a certain amount of flexibility and insuring perfect and easy closing, even should there be a slight obstruction to one of the discs, or a derangement in the angles of the seats, due to abnormal strains in the pipe line. This mechanism has proved very satisfactory.

The discs are faced with bronze disc-rings forced into double grooved recesses in the discs and are guaranteed absolutely steam and water tight. See Fig. 3. This method of attaching the disc-ring to the disc or wedge is found to be a very satisfactory one.

The bronze seat-rings are very heavy and are screwed into the valve body and are renewable. By means of special equipment, designed and manufactured by Jenkins Bros., Limited, the valve body is bored and tapped at both ends for the seat-rings and the bronze seat-rings screwed in and faced off, without removing the body from the chuck:—thus accurately maintaining the angles of the seats.

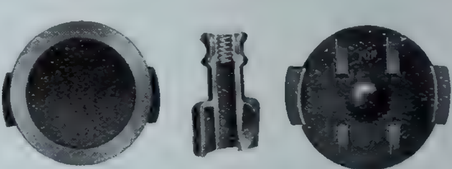


Fig. 3.—

The design of the valve is, in itself, worthy of special mention. The old "box" design has been discarded; the type "K" design being elliptical throughout and therefore devoid of straight lines and sharp angles which develop weakness and are a source of constant danger.

The spindles are made of high-grade bronze, accurately machined to gauge and provided with powerful threads. Great care has been exercised in regard to every detail. The castings, both iron and bronze, are made in the foundries at the plant of Jenkins Bros., Limited, and are the best that can be produced. Each part is carefully inspected, not only in the foundries, but in the various departments through which it passes during process of manufacture.

The valves are made up in large lots of each size by special tools and equipment, of unique design, insuring accuracy and interchangeability and are sold at very moderate prices. In all type "K" valves, the stuffing-box can be repacked while the valve is under pressure and wide open or when closed. Stuffing-boxes are packed with special molded asbestos rings, which will last for years.

These valves are made in all regular styles and sizes—both inside screw and outside screw and yoke—also hub end. as used by the water companies.

Each valve, before leaving the factory, is subjected to a rigid test to 300 lbs. hydraulic and is suitable for a working steam pressure of 125 lbs.

Type "K" iron body gate valves have been on the market only a short time, but owing to their superiority are being used exclusively on most of the important installations, including The Chateau Laurier, Ottawa, G.T.R. Station, Ottawa, Montreal Technical High School, Quebec Technical High School, A. E. Rea Department Store, Montreal, Grey Nun's Hospital, Regina, Bank of Montreal, Winnipeg, Toronto Filtration System, University of Saskatchewan, Saskatoon, and many other contracts.

They have also been adopted by sprinkler companies. These valves are now stocked by dealers throughout Canada and are being exported to England, Denmark, Holland, Russia, South Africa, Australia, New Zealand, China, etc.

These valves are fully described in "Type K Booklet," which will be sent on application to Jenkins Bros., 103 St. Remi St., Montreal

MACKIE PATENT HEATERS.

The Goulds Pump Co., with offices at 513 Coristine Bldg., Montreal, and 20 King St. East, Toronto, have placed on the market a feed-water heater the design of which will appeal strongly to engineers. It is simple, efficient and durable and is built in both types, vertical and horizontal.

The construction of the Mackie heater is as follows:

It is composed of an outer shell or casting and an inner, or tube section. The feature of this heater is the design and construction of the inner or tube section. The tube sheets at both ends of the tubes are entirely free from the shell, thus allowing every chance for expansion and contraction of the tube sheet without any danger of breakage due to the varying temperatures. There is a clearance space between the tube sheets and the outer shell which allows the exhaust steam as well as the water of condensation to pass into the heater base.

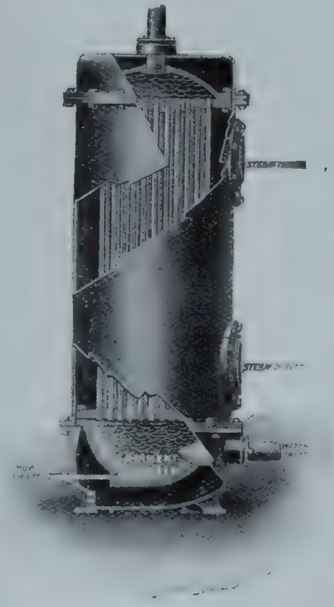
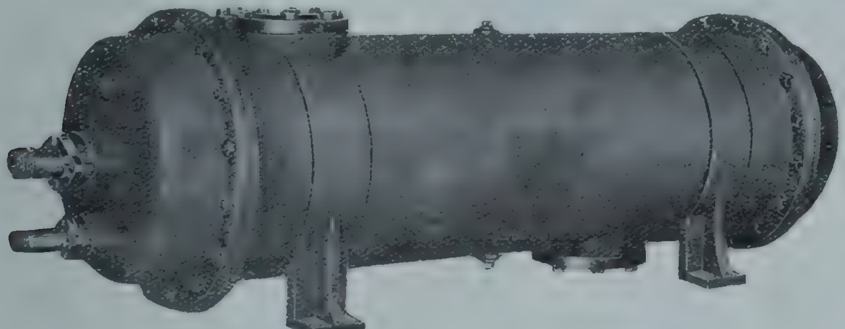


Fig. 1.—Mackie Vertical Feed Hater Heater.

This feed-water heater will very materially improve any feed-water supply, by precipitating into the sediment chamber some or all of the scale-forming matter contained in the water.

It is not necesary to cut these heaters out of service to clean them; all sediment is blown out through pipes for the purpose.

The liability to repairs is infinitely small because of the absolutely free space for expansion and contraction, not only of the tubes but also of the tube sheets or headers. Should repairs be necessary the entire inner parts of this heater may be removed without disconnecting the steam or exhaust pipes.



Mig. 2.—Mackie Horizontal Feed Water Heater.

The Mackie exhaust steam feed water heater will effect a saving of coal of from 8 to 20 per cent. according to the conditions under which they operate.

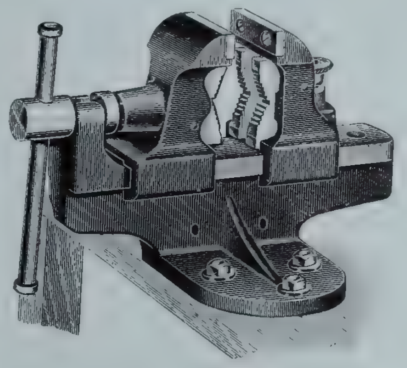
COMBINATION VISE.

The accompanying illustration represents an improvement in quick adjusting combination pipe and bench vises. It is provided with an adjusting pin attached to the back jaws of the vise in such a way that it engages in the base of the vise. It is made of malleable iron and the jaws are of steel.

This base has three holes in which the pin fits. When the pin is in the 1st hole the vise holds pipe from ⅛ to 1 inch, and when in the 2nd it holds pipe up to 2 inches and when in the 3rd hole from 2½ to 3 inches, by tightening the screw.

The advantage to be derived by using this improved vise will readily be appreciated by any engineer or steam fitter as it is so easily adjusted to the sizes of pipe. The above cut also shows the vise proper has steel faced jaws which makes it a good tool to use for filing, etc. Sockets for legs are also provided for this vise by using 1¼ inch pipe for legs so it can be set up any place desired.

This vise is manufactured by the Armstrong Mfg. Co., of Bridgeport, Conn., makers of the Armstrong stocks and dies which are so well and favorably known. A catalog showing the whole line will be mailed on request.



Armstrong Combination Vise.

WEBSTER "STAR-VACUUM" FEED WATER HEATER.

Among the steam heating specialties manufactured by Warren Webster & Co., of Camden, N.J., one of the most important is their line of feed water heaters, manufactured and sold in Canada by Darling Bros., Montreal. The "star-vacuum" feed water heater, purifier, filter and receiver, consists of a cast iron receptacle in which cold water and exhaust steam are brought into direct contact. This open heater is built in regular sizes up to 5,000 h.p. and combines with the usual heating features the purification of the boiler feed water, that may be accomplished at the temperature of exhaust steam and the removal of such precipitates by an efficient filter. A Webster oil separator which is made a part of the heater construction serves to remove oil from the exhaust steam before it enters the heater. An automatically regulated water supply and overflow and a quick opening drain valve or blow-off are provided. The illustrations show one type of Webster heater, class "ED" or horizontal cylindrical type.

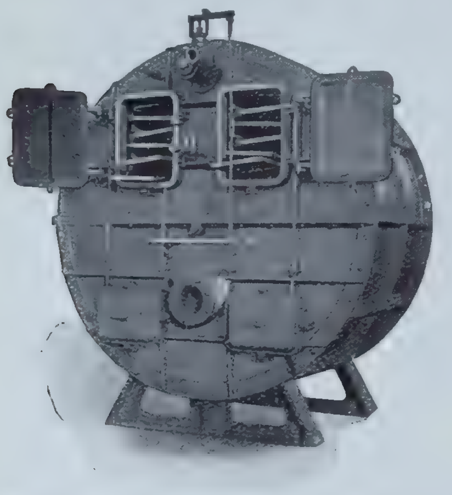


Fig. 1.---Webster Star Vacuum Feed Water Heater

The upper section of the heater consists of a large heating chamber provided with perforated copper trays which distribute the incoming supply water in such a manner as to insure most intimate contact with the exhaust steam. In this type the shell is cylindrical in form made up of sectional plates of close grained cast iron bolted and caulked by the Webster ventilated rust joint. This heater varies from the so-called thoroughfare type of heater in that it is connected by a branch to the main exhaust pipe and uses only just as much exhaust steam as is necessary to heat the amount of water required for the boilers, the connection being arranged to give the heater the preference of flow at such times as the supply of exhaust steam may be limited, thus securing the maximum utilization of the latent heat.

The filter used in connection with this heater is located in the lower part of the shell and is of large cross sectional area. After being heated by the exhaust in the upper part of the heater the water falls through a downcast pipe into the settling chamber above which is located the filter bed, the normal water level being maintained at a definite height by the automatic regulating gear. The heavier solids and impurities are given an opportunity for precipitation in this settling chamber and only the lighter particles reach the filtering material. Through the filter bed the water rises upward to the under side of a division plate, whence it travels to the pump, outlet. By this system of filtration the possibilities of the filter bed becoming clogged through its retention of thick and heavy impurities are greatly lessened and in consequence the bed itself does not need to be replaced so often. A further improvement in the Webster filter is the provision for a reverse circulation in order to clean the filter bed. A connection to the filtering compartment is made from the water supply pipe to the heater with a valve in the pipe, so that the water can be forced through the filtering material in an opposite direction to the ordinary flow. The sediment thus washed out of the filter bed collects in the settling chamber from which it is flushed to waste through the drain or blow-off valve.

The Webster heater is automatic in its operation. Under ordinary circumstances, all that is required is such attention as every engineer gives daily to all parts of the plant under his care. With this and the occasional cleaning that may be needed, the heater will do its work from month to month without further attendance. An added economy may be obtained by the use of this heater in raising the temperature of the condensation from heating pipes, drying kilns, etc. It is already partially heated, but such returns must be properly trapped to the heater.

The heater is sealed from the atmosphere assuring maximum temperature of the feed water when, owing to the variable engine loads, the amount of steam available is limited as the peculiarly Webster method of branch connection literally "draws" the steam to the heater in which a slight degree of vacuum is created by the vacuum effect.

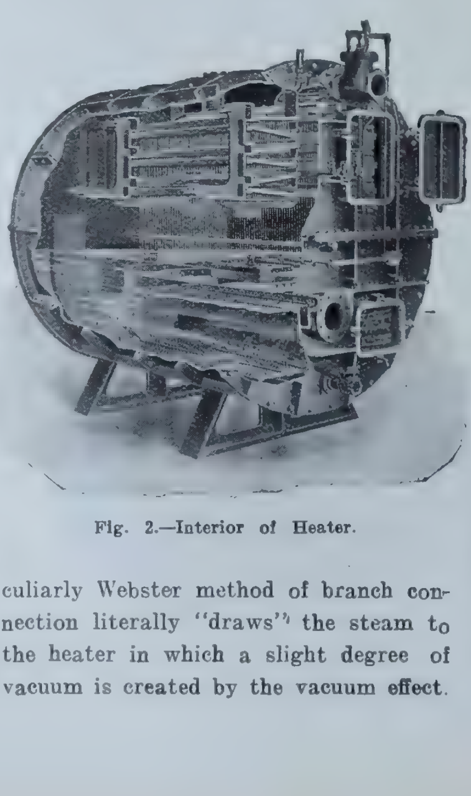


Fig. 2.—Interior of Heater.

WIPING CLOTHS.

A line of wipers prepared by a special process which has been endorsed by the Provincial Board of Health, is being placed on the market by The Imperial Waste & Metal Co., 5-13 Queen Street, Montreal, under the trade name of Imperial Hygienic Cotton Wipers. They are guaranteed to be absolutely hygienic, and it seems that for economical as well as hygienic reasons, they are rapidly gaining favor with progressive manufacturers.

The suggestion of an improvement in the handling and treating of cast-off garments for use as wipers, may come as a surprise to many, but the need of better methods of treating garments has been advocated for many years, and these hygienic wipers are now filling a long-felt want.

The "raw material" for the wipers is large cast-off cotton garments. These are placed in power washers, washed and scalded many times in a strong solution of soda and soap, thoroughly cleansing and sterilizing every part of the material. This process renders the clothes as clean as one's own laundry, and removes all starch or sizing, reducing the weight of the material over 25 per cent., and greatly increasing the absorptive capacity of the cloth. The drying is a special feature of the process, being done in large revolving cylinder machines. Through these a heavy pressure of hot air is forced, thereby drying and carrying off all lint and odor of the wash, and at the same time rendering the clothes very soft. The clean garments are then spread on large tables before competent workers, who cut them up with large shears into convenient sized pieces, ready for use, carefully removing all buttons, hooks, and heavy material, thick seams, etc. This process makes the wipers suitable for use in wiping and polishing the finest furniture or machinery without danger of scratching, and in many large manufacturing and power plants, waste has been discarded and these wipers are used in preference.

The widespread demand that has sprung up since they have been placed on the market shows that these cotton wipers are filling a long-felt want, and men appreciate wipers that are thoroughly clean. One manufacturer reports his men are using them as towels. Already they are used by such representative concerns as the Montreal Rolling Mills, Montreal Light, Heat & Power Co., the Northern Electrical & Mfg. Co., the Shawinigan Water & Power Co., the Montreal Gazette, the Dominion Motor Car Co., the Granby Rubber Co., the King's Printer, Ottawa, the Government Mint, the Canada Car Co., the Ontario Power Co., and many others.

POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

British Columbia.

BLAIRMORE.—The Dominion Wood Pipe Co., New Westminster, are supplying the wire wound pipe required for the installation of waterworks here.

CHILLIWACK.—Immediate steps will be taken towards the acquiring of water rights on Ford creek. On the granting of this, a company will be organized to install a system of waterworks to provide Rosedale with water for domestic and fire purposes.

NEW WESTMINSTER.—The British Columbia Packers' Association, owners of the Columbia Cold Storage plant which has a capacity for storage of about 2,500,000 pounds of fish, contemplate building an addition with 100 feet water frontage which would increase the storage capacity about one-half. The company is also considering the erection of a cold storage plant at Vancouver.

PRINCE RUPERT.—Work is progressing on construction of the new plant for the Canadian Fisheries & Cold Storage Co. The necessary building including wharves with 340 feet water frontage. The refrigerating plant will consist of three 75-ton machines and 50-ton ice making system. Some 50,000 feet of 1¼-inch piping will be required for the sharp freezers and 22,000 feet of 2-inch d.e. pipe for storage rooms. Bids for these, however, will not be called before February or March next. Geo. L. Clayton, Seattle, Wash., is the consulting engineer.

VANCOUVER.—The Canadian Fish Co., the Canadian branch of the New England Fish Co., it is stated, is preparing to build a cold storage and fish freezing plant, the former to be of 6,000,000 pounds capacity and the latter large enough to freeze 100,000 pounds of fish daily. A 50-ton ice making machine also will be installed.

Alberta.

EAST CALGARY.—Tenders will be received for laying fifty thousand brick or more. C. C. Snowden, wholesale oil merchant, Box 1384.

EDMONTON.—A cold storage warehouse is to be erected here in the near future, application for government subsidy having been made.

MEDICINE HAT.—C. J. McKenzie, representing Mr. Maxwell, consulting engineer, is in the city with line foreman, Mr. Bray, and work has been started on the construction of the electric power and light plant and distributing station.

Saskatchewan.

YORKTON.—The council is undecided whether to install a municipal steam or gas producer plant. To decide whether the grades of coal obtainable in the West are suitable for the operation of a gas producer plant, a deputation have inspected the gas producers in operation in several U.S. cities.

BIGGAR.—It is proposed to expend about $15,000 for waterworks improvements.

FORT SASKATCHEWAN.—Chapman & Walker have received an order for a 150 k.w., 6,600 volt Bergmann generator and auxiliary equipment. The generator will be driven by a turbine manufactured by William Hamilton, Peterboro.

SWIFT CURRENT.—The council have placed with Chapman & Walker, Toronto, contracts for one Crossley 208 h.p. 2 cylinder gas engine belted to an A.C.B. generator; on Crossley 54 h.p. 1 cylinder gas engine belted to an A.C.B. generator, one gas engine and compressor, transformers, switchboard, etc., one Crossley 95 h.p. gas engine to operate one turbine pump 624 imp. gals. per min. at 125 lbs. pressure, 1,200 r.p.m.; one Crossley 85 h.p. gas engine to operate turbine pump 416 imp. gals.; two Crossley suction bituminous type gas plants each 220 h.p., 100 watt tungsten lamps, etc. Price $45,750.

SASKATOON.—The city has decided to place a contract with the Canadian Boving Co., Montreal, for a standard 150 h.p. three cylinder Mirrlees-Diesel oil engine and a Siemens generator for the municipal plant. The present power plant will be extended to house the apparatus.

Manitoba.

BRANDON.—The ratepayers will vote at an early date upon a waterworks by-law to issue $50,000.

Ontario.

WINDSOR.—The Imperial Electric Co., has been incorporated, capital, $50,000. Provisional directors are E. J. Rumsey, C. P. Blachly, A. W. Rumsey, Miss A. W. MacGregor, and Miss C. E. Phillippo.

TORONTO.—Factory Products, Ltd., Confederation Life Building, Toronto, are moving into more commodious quarters in the Nicholls Building, King St. West. The Nicholls Building is a new structure erected specially for this company.

OTTAWA.—Allen Hazen, a New York expert engaged to investigate Ottawa's water supply, has reported that the Ottawa River, the present source of supply, is contaminated by sewage and that 80 per cent. of the water pumped is lost by leakage. He recommends that McGregor's Lake be the natural reservoir drawn upon or that a complete filtration plant be installed. The adoption of the first recommendation would call for an expenditure of $2,400,000 on works, and the adoption of the second would call for an expenditure of $2,300,000. The city council received the report, but left action upon it for a subsequent meeting.

OTTAWA.—Under the name of the Schawb Boiler Heating Co., a company has been formed by J. Schawb, of Winnipeg, Alex. Campbell, J. L. Webster, A. E. Fripp, M. L. A., and T. D'Arcy McGee, of Ottawa, to take over the patents of John Schawb for the heating of a plurality of boilers with one fire, and to undertake the manufacture and installation of all kinds of heating apparatus. The head office of the company will be Ottawa. Capital $100,000.

FORT WILLIAM.—Hugh Armour & Co. have been incorporated for the purpose of erecting a large abattoir and cold storage plant. The men chiefly interested in the company are Hugh Armour and Robert Armour, of this city, and Mr. Paisley, of Scotland. Capitalization, $250,000.

ST. CATHARINES.—A by-law will be voted on in January by the ratepayers to issue $75,000 waterworks debentures.

TORONTO.—The works committee of the council have decided to engage Rudolph Hering, New York, at a fee of $3,000 to report on the question of establishing garbage incinerators.

COBALT.—Work has been started on the development of a hydro-electric plant on the Mattagami River at Sandy Falls in the Porcupine district, six miles from the Timmins Mine. Three thousand (3,000) horsepower in generators has been ordered from the Canadian Westinghouse Co., and turbines of like capacity from the S. Morgan-Smith Co., New York. This plant will be in operation by June 1st, 1911. Current will be generated at a pressure of twelve thousand volts and a frequency of twenty-five cycles per second.

NIAGARA FALLS.—The Hydro-Electric lines are to be exempt from taxation. A court of revision of taxes was held in city hall. The appeal of the Hydro-Electric Commission was brought before the court. It was decided in their favor, and the assessments made on their lines and conduits which are on the boundaries between this city and the township of Stamford were repealed.

TILLSONBURG.—The clerk has been authorized to advertise for a superintendent for the town's hydro-electric power and light system.

Quebec.

MONTREAL.—A charter has been issued incorporating the Imperial Engineering Co., capital $100,000 with head quarters here. The prime mover in the enterprise is Lawford Grant, of the Canadian British Insulated Co. It is the intention of the new corporation to carry on general electrical construction work including the building of electrical railway, hydro-electrical plants, etc.

MONTREAL.—The British Insulated Cable Co. have recently closed two very large orders, one with the city of Ottawa and the other with the city of Winnipeg, for the entire supply of transmission cable in connection with their municipal systems.

MONTREAL.—The new refrigerating plants installed for the Rideau Club, Ottawa, the Harris Abattoir, Toronto, and the plants for the T. Eaton Co., Ltd., at Toronto and Winnipeg, mentioned in the September issue of The Power House, were furnished and installed by The Kent Co., Ltd., Montreal, who are Canadian agents for the York Mfg. Co., York, Pa.

MONTREAL.—The contract for installation of filtration plant for the Montreal Water & Power Co. is in the hands of Laurin & Leitch, Montreal.

HULL.—The addition to the Hull pump house is nearly completed and the pumps, with a capacity of 7 million gallons per day, will be installed this fall by William Hamilton Co., Peterboro.

Nova Scotia.

NEW GLASGOW.—Contract will probably not be let until spring for the proposed waterworks. J. Roy, town clerk.

HALIFAX.—The Scotia Pure Milk Co. is preparing to erect a modern ice cream factory to be equipped with refrigerating plant.

Trade Notes.

Escher Wyss & Co., Zurich, Switzerland, with offices at 109 Victoria St., London, Eng., have received an order for two turbines for an output of 10,000 h.p. for the Stove Lake power plant of the Western Power Co. These are fitted with oil pressure governor. They have also received an order for a 10,000 h.p. turbine from the Shawinigan Water & Power Co.

Machinery for N. T. Ry. Shop.

The specifications for the supply of the machine equipment for the National Transcontinental Ry. repair shop at the 18-stall roundhouse, at Lake Superior Junction, Ont., as the place is called in the advertisement, or Graham, Ont., as it is called in the specifications and accompanying blue prints, provide for the supply and erection complete of the machinery, with the necessary motive power, as follows:—

Engine, Generator and Switchboard.—One 50 k.w., d.c. generator, 250 volts, to be mounted on extension base or engine; calculated to deliver its full rated load continuously, with a rise in temperature not to exceed 20 deg. C., in any part of the machine, and carrying 25 per cent. overload for a period of two hours immediately following the above, with a temperature not exceeding 55 deg. C.

One simple non-condensing steam engine, to be direct connected to above generator both units to be mounted on the same base. The engine to be of the enclosed type, horizontal sidecrank; steam pressure 110 lbs., maximum back pressure 5 lbs.; it shall develop its full load rating at ¼ cut off, and shall be designed to carry an overload of 50 per cent. continuously without overheating in any part.

The switchboard is to consist of one generator panel and one feeder panel.

Air Compressor.—One horizontal, duplex, steam driven air compressor, designed for steam pressure at 110 lbs., maximum back pressure 5 lbs., capacity 700 to 800 cubic ft. of free air a minute, at a speed not exceeding 100 revolutions a minute. Automatic speed and pressure regulator to be provided, and to be operated by the air pressure in the receiver.

One vertical air receiver 54 by 12 in., of the best steel, riveted, and to be tested to 175 lbs. water pressure, and guaranteed safe and tight for a working pressure of 125 lbs., and equipped with necessary screwed openings, valves, etc.

CATALOGUES.

POWER PLANT ACCESSORIES.—The Power Economy Co., 9 St. Nicholas St., Montreal, have compiled a neat catalogue containing descriptions of a number of time, labor and fuel saving devices, for which they are selling agents. Among the lines listed are F. & W. Packing; Crecent grate bar and Economic steam blower; Locke automatic engine stop and speed limit; Chaflin tube cleaner, hose and hose fittings; Liberty power plant specialties including steam and oil separators, strainers, etc. Prices are included in the catalogue making it a valuable one for engineers. Mention The Power House when writing for it.

MILL SUPPLIES.—J. R. Baxter & Co., Montreal, have issued a supply catalogue giving prices for Kebo belting and packing, tool hose, steam hose and mill hose; emery wheels and safety life saving device for emery wheels; Kebo hacksaws, cotton waste, hollow set screws, gears, pulley blocks, Kebo babbitt metals, Bishop's gauge glasses, vises, taps, wrenches, etc. Kebo belting is manufactured from camel hair yarn. The Kebo high pressure asbestos sheet packing is for use where acids, alkalies, ammonia, hot sugar, oils, etc., are handled. Catalogue will be mailed on request to readers of The Power House.

DE LAVAL CENTRIFUGAL PUMPS.—De Laval Steam Turbine Co., Trenton, N.J. Paper; 6 x 9 ins.; 96 pp. A most interesting book for hydraulic engineers and users of pumping machinery. In connection with the description of nearly all pumps, which are illustrated by diagrams and half-tone cuts, are various remarks and information on the principle of design of such pumps and their selection for various services. Curves showing the test characteristics of all the various types of centrifugal pumps which were designed for different conditions and operated by motor or steam gre given. These tests include various sizes of single and multi-stage pumps.

"A STUDY IN HEAT TRANSMISSION"—By J. K. Clement and C. M. Garland, is issued as Bulletin No. 40 of the Engineering Experiment Station of the University of Illinois. The bulletin describes a method of studying the effect of the agitation of a medium in contact with metal walls upon the heat conducted through these walls and to or from the medium. Results of experiments upon the heat transmitted to water as the medium in contact with the walls of a tube, under varying velocities or rates of agitation, are given. Copies of Bulletin No. 40 may be obtained gratis on application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois

TREATISE ON CLUTCHES, PULLEYS, BELTING GEARS.—A great saving may be made in power transmission by using modern systems and appliances. The latest developments of the Positive Clutch & Pulley Works are described in a 31 page book. A fund of information is contained in it and it is a valuable one to have on file for reference.

ELECTRIC WATER HEATER.—Publication No. X 119, from Veritys, Ltd., 28 King St., Covent Garden, London, England, describes the Electric Geyser, an electric water heating appliance which they manufacture. The varied uses to which it can be put are shown with illustrations, and lists of prices, sizes, etc., given.

SUPPLEMENTS.—Two different types of dry cells are described in a couple of supplements from Veritys, Ltd., 28 King St., Covent Garden, London, England. The principal features of each is given on its respective supplement sheet.

FITTINGS.—The 16 page booklet issued by Veritys, Ltd., 28 King St., Covent Garden, London, England, which is their publication No. 613, lists the various types of main switches, fuses and circuit-breakers, that they manufacture. Numerous types and sizes are shown, and the price and capacity of each given.

PERTH WATER GAUGE GLASSES.—John Moncrieff, North British Glass Works, Perth, Scotland, gives some valuable hints on gauge glasses in the catalogue on Perth gauge glasses. Various types of glasses are described as well as gauge glass cutters, washers and glass lubricators.

GASKETS AND PACKINGS.—The American Goetze-Gasket & Packing Co., New Brunswick, N.J., U.S.A., have issued a very neat 38 page catalogue in colors dealing with copper and metal gaskets and metallic packings. Engineers should have this booklet in their library for reference, the pages devoted to shapes and applications being of special value to the engineer.

ECONOMIC VACUUM VALVE.—Recent improvements made by the Canadian Steam Boiler Equipment Co., 186 Queen St. East, Toronto, have made the Economic Vacuum Valve of great value in the installation of steam heating systems. A pamphlet issued by this company describes this vacuum valve.

STEAM SPECIALTIES.—Darling Bros., Montreal, handle or manufacture a complete line of steam specialties. These are enumerated and illustrated in a 32 page booklet recently issued by them.

AUTOMATIC OILING AND FILTERING SYSTEM.—Bulletin 115 issued by the Richardson-Phenix Co., Milwaukee, describing the Richardson complete automatic oiling and filtering system.

A DOLLAR SAVED IS BETTER THAN A DOLLAR EARNED.—The Fisher Fuel Economizer Co., 74 Bay St., Toronto have issued a neat booklet describing the use of Fisher Fuel Economizer and giving letters from users of the economizer.

POWER COST.—Costs of various operating plants are given in a pamphlet issued by the Canada Producer & Gas Engine Co., Barrie, Ont.

DETROIT MULTIPLE OILERS.—A pamphlet gives the sizes and price of multiple oilers for gas, gasoline or oil cylinder and bearing lubrication, manufactured by the Detroit Lubricator Co., Detroit.

WEBBER GASOLINE AND GAS ENGINES.—Type C engines are fully described in a catalogue recently issued by the Canada Producer & Gas Engine Co., Barrie, Ont.

CONDENSERS FOR SMALL CENTRAL STATIONS.—Is the title of a 24-page pamphlet published by the Wheeler Condenser & Engineering Co., of Carteret, N.J., in which is reprinted a lecture delivered before the Missouri Gas, Electric & Street Railway Association. It contains a number of useful tables, charts and curves relating to the operation and economy of condensing machinery. The effect of vacuum on the steam consumption of simple slide valve, compound, high speed and low speed engines and steam turbines is first discussed, and then the other economies to be obtained by using condensing machinery, for instance, the reduction in boiler capacity, are taken up. The basic principles of condensing machinery are next discussed, including an explanation of Dalton's Law in respect to the influence of air upon the efficient operation of the condenser and the effect of the pressure and temperature at the air pump suction upon the efficiency of the pump. The application of these principles to the design of both surface and jet condensers is then pointed out. With respect to jet condensers, a report of two tests is given, showing the advantages of the countercurrent construction of the Wheeler Rectangular Jet Condenser as affecting economy of operation and the attainment of high vacuum. mhe subject of air pumps is also considered, a typical indicator card from a dry air pump being reproduced. Under the heading, "Surface Condensers," several pages are devoted to the various factors which influence the transmission of heat through condenser tubes and their bearing on the economy of a surface condenser. The text matter is illustrated with 14 figures and curves. Copies of this pamphlet may be had by application to the Wheeler Condenser & Engineering Co., Carteret, N.J.

BRISTOL INSTRUMENTS.—The following bulletins have been received from the Bristol Co., Waterbury, Conn.:—116 class II recording thermometers; 128 round form class II., 8-inch recording thermometer; 129 thermometer-thermostats, class I and II; 135 recording shunt ammeters; 141 round form recording pressure gauges; 145 class II indicating thermometers; 146 long distance recording tachometer; and 147 Bristol-Durand radii averaging instrument. Copies of any of these will be sent to engineers on request.

INDUSTRIAL THERMOMETERS.—Bulletin 39 from the Industrial Instrument Co., Foxboro, Mass., describes the dial type thermometer for temperatures 50 to 500 degs.

THE DIFFERENCE BETWEEN ALBECO LAMINATED AND MULTI-LAP LEATHER BELTING—Is the title of a booklet being distributed by the American Laminated Belting Co., 113 Hudson St., New York. This booklet is especially interesting in that it gives close comparisons of the operating principles, power transmitting qualities and ultimate economy of belting. That laminated belting can handle heavy loads is shown in this booklet by the description of the main drive in the Cocheco Department, Pacific Mills, Dover, N.H., where 84 inches width of laminated belt on one pulley are transmitting 1,544 h.p. These belts consist of two 30 inch and one 24 inch belt, all ⅝ inches thick, and are said to comprise the largest installation of laminated belting on one drive in the world.

BOILERS.—The Goldie & McCulloch Co., Galt, have issued a 56 page treatise on boilers. It is printed on coated paper, data is well arranged and illustrations are clear and distinct. Engineers will find a perusal of it interesting.

VULCAN MECHANICAL FUEL FEEDERS—Is the subject of a 20 page catalogue issued by W. H. Adams, 102 Nazareth St., Montreal, special sales agent of Vulcan Furnace Co., for Eastern Canada. Full description with illustrations is given for the benefit of engineers interested in smokeless combustion of fuel.

WATER PIPE.—A booklet from the Michigan Pipe Co., Bay City, Mich., describes their combined iron and wood water pipe tested to 200 lbs. per sq. in. and gives some valuable data on piping.

BLOTTER.—Power Economics, 9 St. Nicholas St., Montreal, are mailing a blotter which en-

Don't Borrow—Have Your Own Tool

¶ A little leak between a tube and the face plate of a boiler is liable to cause the shut-down of a plant unlsss there is a reliable tube expander righ handy.

And you can never rely on getting the loan of an expander just exactly when you want it.

Why risk a shut-down when you can get for a very moderate price the world's best tool for cutting, trimming and expanding tubes;

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With the Liberty Cutter and Expander most of the difficulty and all the unpleasantness is removed from the task of replacing burnt or ruptured tubes.

Before passing along write us for interesting illustrated bulletin about this indispensable tool

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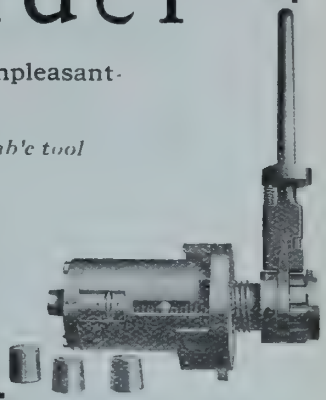

APPLIANCES THAT REALLY ***DO*** CUT DOWN EXPENSES AND INCREASE EFFICIENCY

On this page you see some Elliott Power Plant Appliances that have earned places in thousands of modern power plants through sheer indispensability. Engineers in whose plants these appliances are in active service have no doubt of their supreme efficiency, because every day's experience confirms it

"ELLIOTT" Feed Water Regulators
Reducing Valves, Steam Traps
Twin Strainers, Oil Separators

are, by long odds, the best appliances of their kind ever known. Their use in YOUR PLANT will result in perfect safety, smooth working of boilers and engines, reduced repair bills and decreased consumption of fuel.

As a progressive engineer it is up to you to extend your acquaintance with Elliott steam specialties. Commence by writing for our Bulletin.

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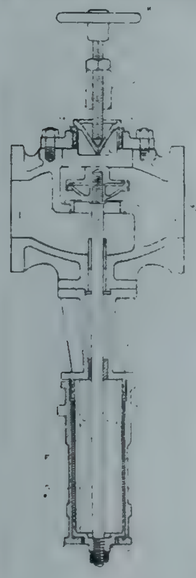

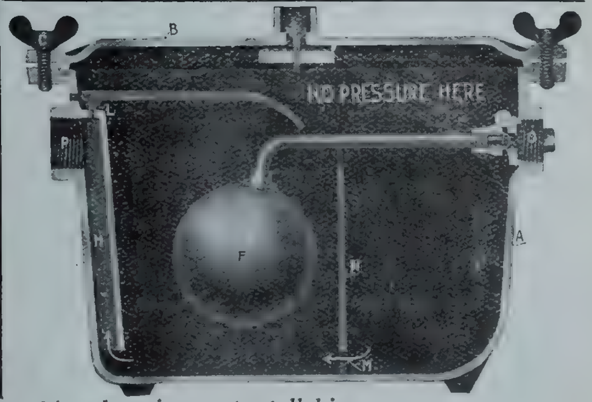

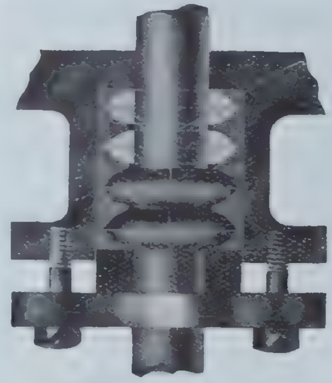

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is what we guarantee to users of

The Rhodes Improved Metallic Packing

It stays packed under the most trying conditions and will not injure any rod.

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Write to-day for particulars

Eugene F. Phillips Electrical Works, Limited

MONTREAL CANADA

Bare and Insulated Electric Wire

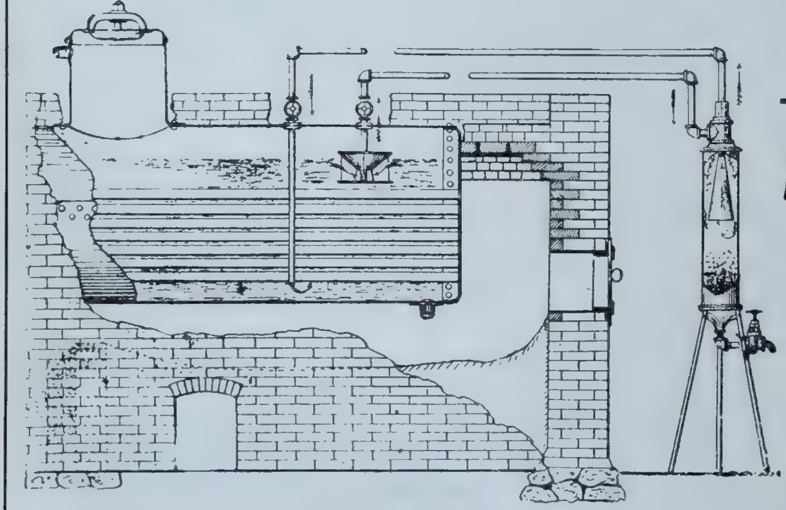
Electric Light Line Wire. Incandescent or Flexible Cords.

Railway Feeder and Trolley Wire

Americanite, Magnite, Office and Annunciator Wire. Cables for Aerial and Underground Use.

HALIFAX TORONTO WINNIPEG VANCOUVER

Prevention is Better Than Cure



There is just one effective way to keep a boiler free from scale formation, and that way is to use the

MYERS

Automatic Boiler Cleaner

Its logical simplicity of construction will at once appeal to you as a practical engineer. *You take no risk.* We take all chances and give every purchaser the opportunity of trying our boiler cleaner before purchasing. If we did not have a good article we could not do this.

First, examine the cut. The conical deviee let into the top of the boiler and the cylinder standing upon a pedestal, back of the boiler are the two essential features of the Myers Cleaner. The conical device is connected by a slotted tube and four ribs to a disc; it is called the "Skimmer." In the precipitator the impurities are forced to the cooler outside part and precipitated to the bottom where they may be blown off from time to time. The clarified water then rises through the funnel into the piping and is conveyed to the bottom of the boiler entirely freed from scale-forming elements. The ribs in the skimmer serve to break up the scale-forming scum which always rises to the top of the boiler, while the cone guides the scum-laden water into the slots of the tube. The disc catches and retains such scum as fails to enter the tube. From here the scum-laden water rises in the tubes and descends into the cylinder called the precipitator.

This Cleaner is Entirely Automatic in Operation

and will outlast any boiler to which it is attached. It does entirely away with boiler scale and its attendant dangers and inconveniences, thus eliminating the expensive stoppage of machinery so frequently necessary where scale is permitted to form in a boiler.

Send for catalogue giving full particulars. Write for it to-day.

C. B. TURNER & COMPANY, P.O. Box 354, TORONTO, CANADA

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THE LINDE {AMMONIA and CARBONIC ACIDS} SYSTEMS

For Cold Storage and Ice Making Plants

Patent Seamless CORK INSULATION—Efficiency With Economy

Send for our catalogue showing details of installations and containing many useful tables and other data concerning this industry.

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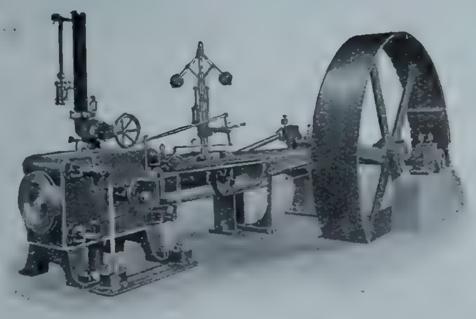
COMPLETE PLANTS DESIGNED AND INSTALLED



Girder Bed Corliss Engine

Catalog on application

ESTABLISHED 1867

The VILTER MFG. CO.

242 Becher Street, Milwaukee, Wis., U.S.A.

BUILDERS OF HIGH-GRADE

CORLISS ENGINES

Simple or Compound, Girder or Heavy Duty Bed. Any size, 30 to 1,000 H.P.

Ice and Refrigerating Machinery

gineers will find useful. Its object is to keep before the engineers the F. & W. metallic packing.

RESULTS.—One of the neatest folders that has reached our desk during the month was issued by the Chapman Double Ball Bearing Co., 347 Sorauren Ave., Toronto. It contains letters from manufacturers who use Chapman Double Ball Bearing. Accompanying the folder is an article "Transmission Appliances that Prevent Power Loss," by W. E. Cane, reprinted from The Power House.

SAVING OF HEAT UNITS.—H. L. Peiler & Co., Montreal, dealers in steam specialties including the Bundy trap is mailing reprints of the article "Saving of Heat Units" which appeared in the August issue of The Power House.

WEBSTER SYSTEM OF HEATING.—Darling Bros., Montreal, are mailing reprints of the article on the Webster System of Heating, by Richard Dawson, which appeared in the August issue of The Power House.

AUTOMATIC ENGINE STOP.—The value of an engine stop and a description of the Strong Automatic Engine Stop is the subject of a catalogue issued by the Strong, Carlisle & Hammond Co., Cleveland, Ohio. Readers of The Power House may obtain copies by writing this company.

DUNHAM VACUO—VAPOR SYSTEM OF HEATING.—The National Vacuum Heating Co., Marshalltown, Iowa, of which the C.A. Dunham & Co., 511 Continental Bldg., Toronto, is the Canadian branch, have issued a neat catalogue on coated paper, describing fully with illustrations the Dunham system of heating and their trap which contains many interesting features recommending it to engineers.

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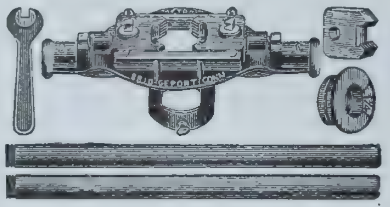

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BOOK REVIEWS.

STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS.—Third edition published by the McGraw-Hill Book Co., 239 west 39th St., New York, leather covers, 1,500 pages 4 x 7 ins., illustrated. Price $4.00.

This reference book has been thoroughly revised. The book is 200 pages larger than before, with many new reference tables and altogether about 40 per cent. is new matter. The book is edited on the unit system, there being twenty sections, a number of the sections being prepared by the compiler, Otis Allen Kenyon, and the others by specialists on the particular subjects prepared by them.

A feature of the book is the manner in which the real subject of each paragraph is brought out prominently in a bold face type, the idea being to save the time of the reader.

While possibly a few errors have crept into this volume from typographical or other causes the compiler has succeeded in producing a valuable volume. Among the subjects treated are Units, Electric Circuits, Measurements, Properties of Materials, Magnets, Condensers, etc., Transformers and Converters, Generators, Motors, Batteries, Central Stations, Transmission, Illumination, Electric Traction, Electrochemistry, Telephony, Telegraphy, Applications of Electricity, Wiring, Standardization Rules, and Tables and Statistics.

I here enclose the sum of one dollar $1.00, for my subscription to The Power House ending Sept. 1910, which I am well pleased with, and think that it cannot be surpassed by any of its kind.—Wm. Foster.

The presentation of further experimental data in regard to superheated steam will be looked forward to with great interest, but what we now need is a thorough review of the properties of saturated steam. At present our knowledge of the heat required above saturation is probably more accurate than what we know about saturated steam.—Prof. R. C. H. Heck.

O'Brien stepped into the door of Casey's engine room one morning and found that worthy member tinkering with a balky pump and swearing softly to himself. Thinking that he saw a good chance to "put one over" on him, he remarked: "Casey, ye'd bether kim over t' th' wather works tomorrer, they air goin' t' pull aff an intherestin' ingineerin' axperimint."

Casey looked up, and being caught off his guard by the innocent look on O'Brien's face, "bit" easily.

"What air they goin' t' do, O'Brien?" he asked.

With a broad grin O'Brien replied: "They air goin' t' dehorn th' hydraulic ram."

And the next moment he was busy getting out of the door just a few inches ahead of Casey's No. 10 brogan.—Power.

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Jersey City, New Jersey

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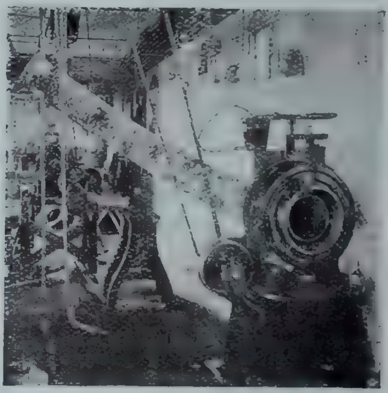

Will cut and thread pipe bends of all kinds and sizes. Requires only one man. And a big point in its favor is the fact that the dies are turned around the pipe, both the machine and pipe remaining stationary.

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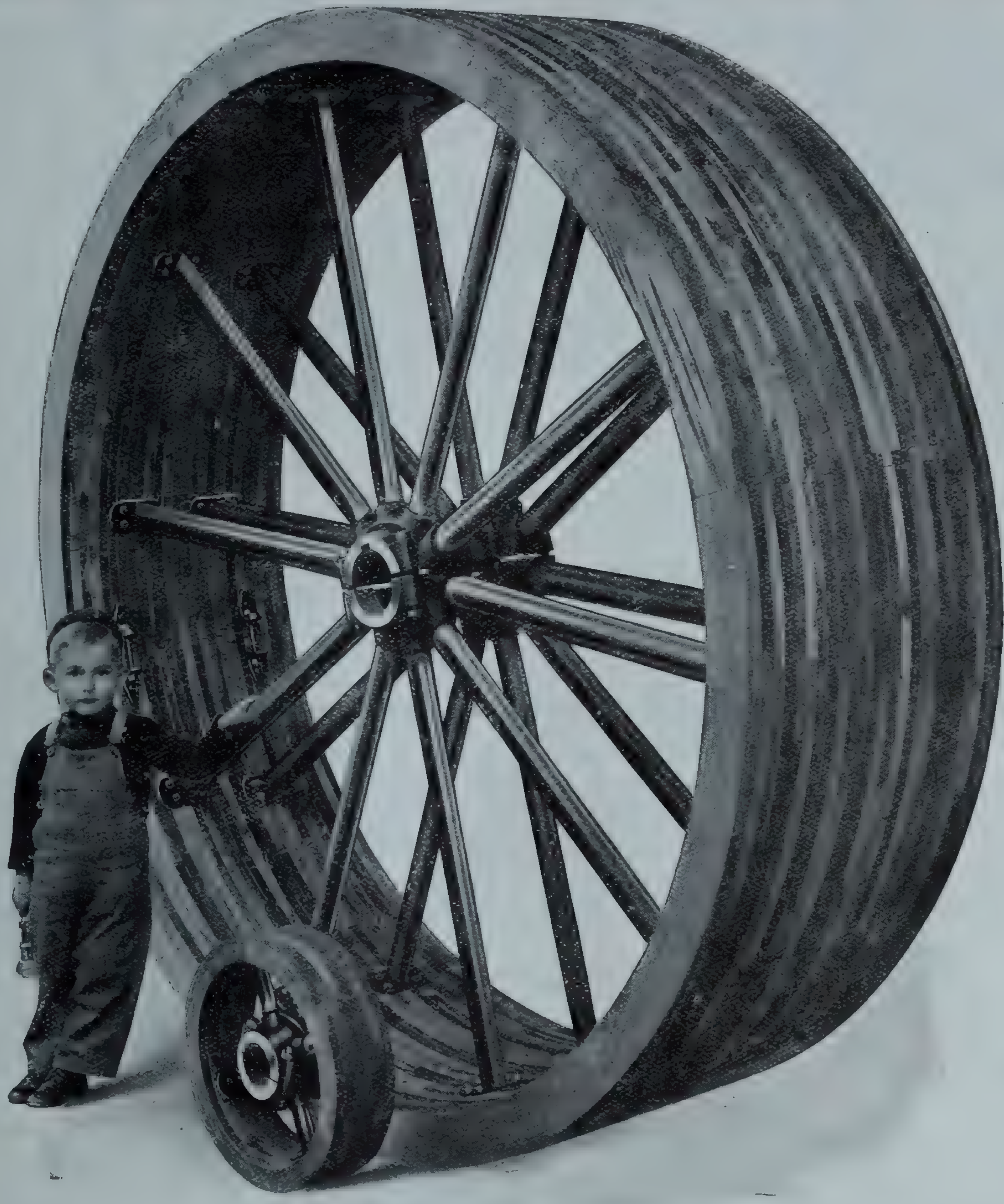

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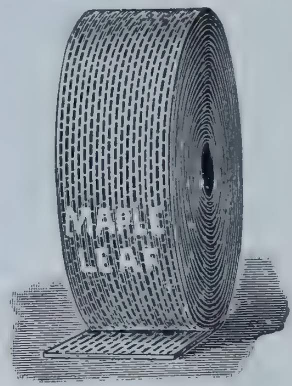

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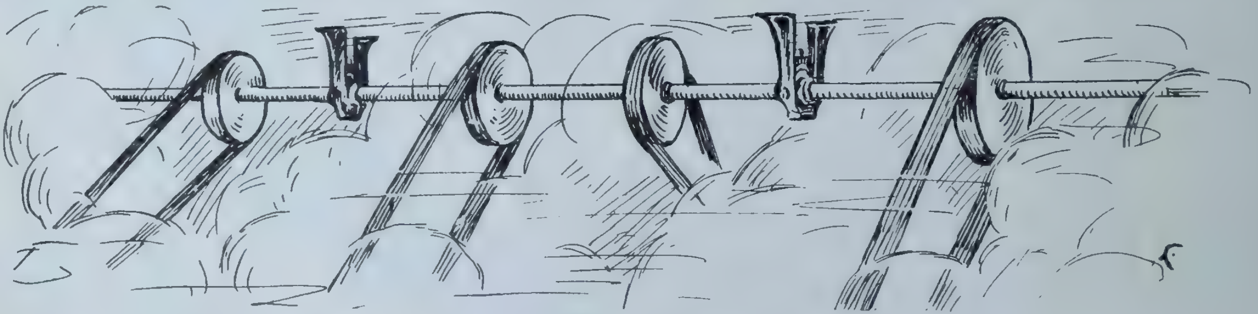

will soon ruin ordinary leather belting, but it will never injure

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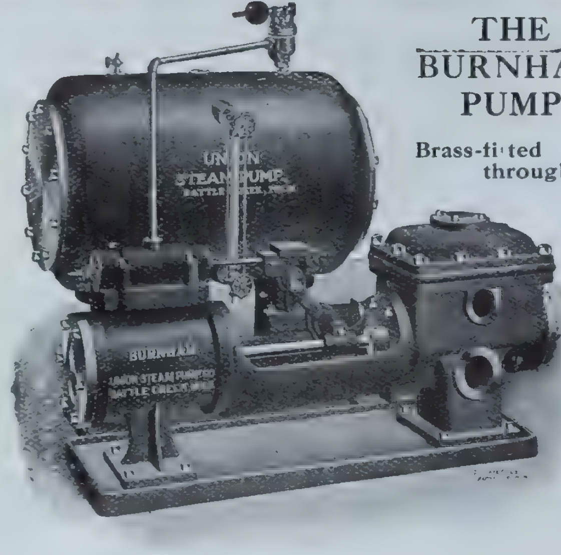

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By joining one of the subordinate associations of the C.A.S.E. you can gain knowledge of the character which is deemed so essential by successful practitioners of all the useful professions.

In all fairness I would ask you if an organization devoted to the calling at which you earn your daily bread is not entitled to special consideration from you?

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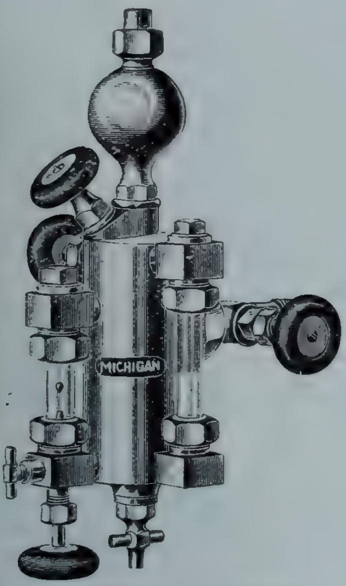
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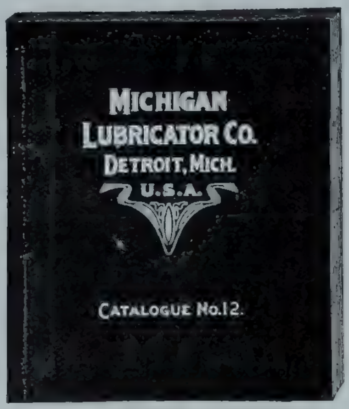
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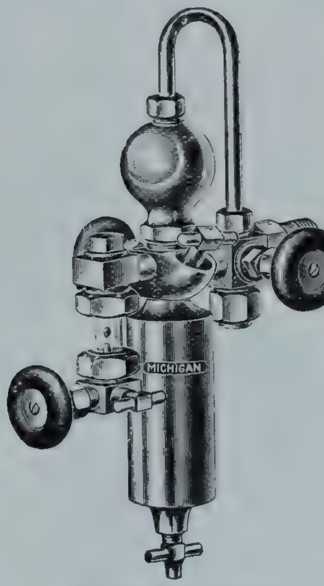
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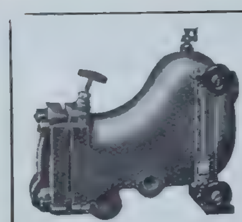

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FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

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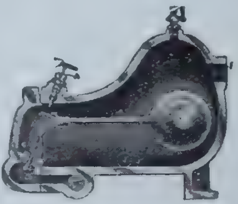

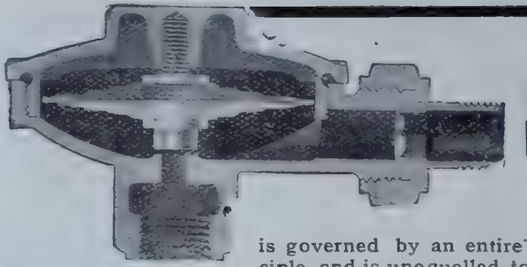

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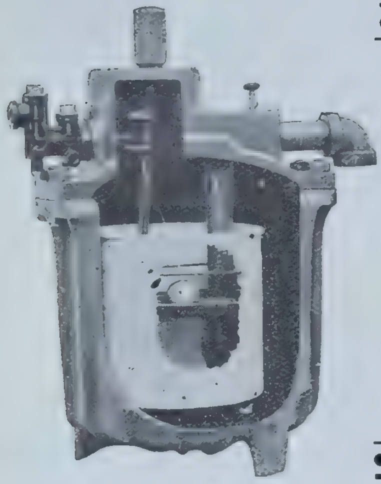

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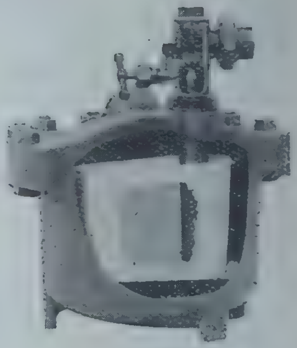

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WHAT method are you using to drain your steam systems? Is it simple, economical and reliable? If there is quite some condensation does it return it to the boilers as feed water? This is the method you should use and this free book will tell you all about it. It concerns the Morehead Tilting Return and the Morehead Tilting Non-Return Steam Trap.

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"We were wasting a great deal of steam through condensation," writes a customer, "and in looking around for something to return the hot water to the boiler, decided on a Morehead Trap. It has been in constant use for five years, yet we have spent but five dollars for repairs, and all the attention it requires is packing occasionally."

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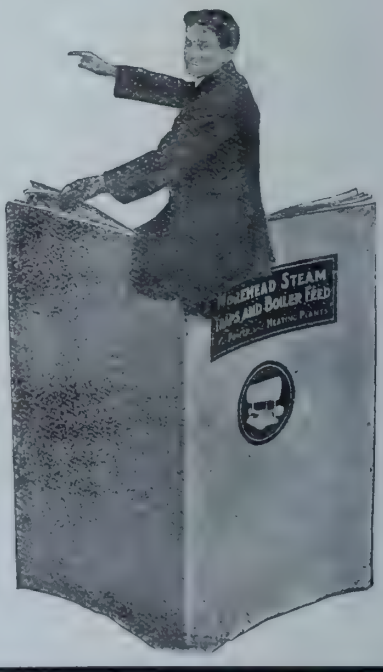

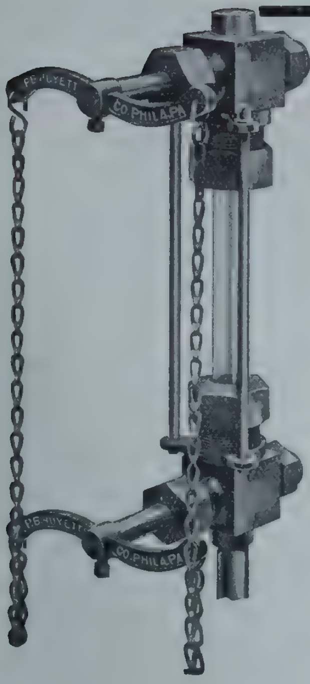

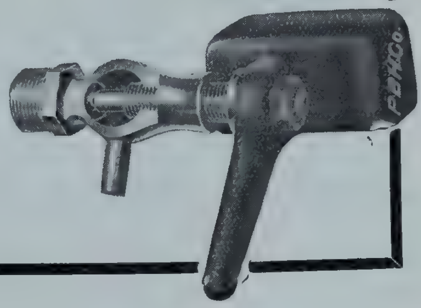

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Here are three devices indispensable
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The "P.B.H." Quick Closing Water Gauge

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Insures against burns and scalds. A pull shuts off steam and water in case of a broken glass.

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The "Tornado" Steam Boiler Tube Cleaner

Works thoroughly, rapidly and economically. Carries no moisture to wet soot, and blows through the longest tubes.

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Is guaranteed leakless for years. Simple, efficient, economical and quickly repaired.

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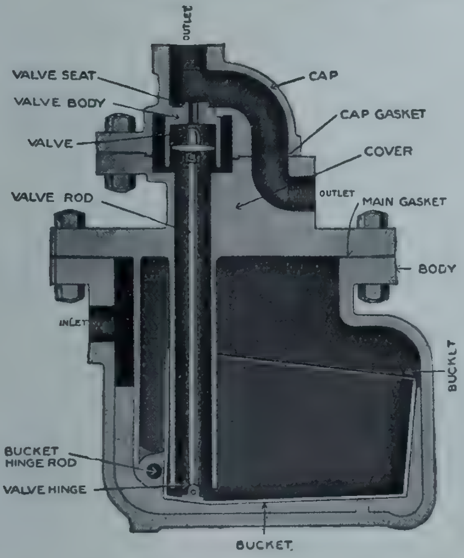

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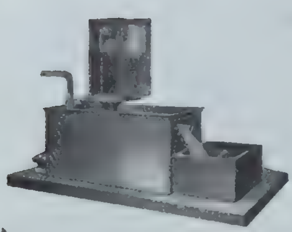

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"Self Contained Apparatus" for measuring

BOILER FEED-WATER
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and other flows, by means of the V notch.

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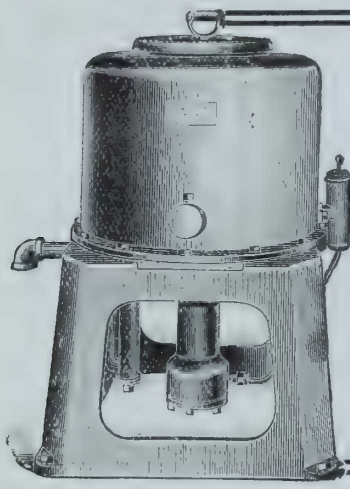
Everyone operating a Stationary Steam Plant of 50 h.p. or over, in the Province of Ontario, must hold a Certificate from this Board. Anyone operating such a plant without a Certificate is liable to the penalties set forth in the Stationary Engineers' Act

J. S. DUFF,
Minister of Agriculture.

W. C. McGHIE,
Chairman of Board,
Parliament Buildings, Toronto.



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We have machines with---The E. B. Eddy Co, Ltd.; Grand Trunk Railway; Can. Pac. Ry.; Dominion Coal Co.; J. R, Booth; Toronto Water Works; T. Eaton Co.; Montreat Street Ry.; Nova Scotia Steel & Coal Co.; Toronto Railway; Algoma Steel Co.; Quaker Oat Co.; B. Greening Wire Co.; Imperial Oil Co.; Canadian Copper Co.; Sarnia Electric Light Co: Robert Mitchell Co.; Montreal Rolling Mills; Canada Screw Co.; Crow's Nest Pass Coal Co.; Dominion Iron & Steel Co.; Temiskaming & Northern Ontario Railway Co.: Consolidated Mining & Smelting Co.: Montreal Cotton Co.: Frost & Wood Co., Ltd.; Dominion Textile Co., Ltd., and many others.

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Serve Notice on the Scale in Your Boilers to Move Out

Bird-Archer Boiler Compounds will evict it on the shortest possible notice---will clean it out thoroughly, and will keep NEW scale from moving in and settling down to insulate and destroy your tubes.

Bird-Archer Compounds are the Made-For-You Kind

THE BIRD-ARCHER COMPANY'S
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BOILER COMPOUNDS

We Invite You to try Bird-Archer Compounds at our Risk and Expense

They're compounded in the light of full information as to what *kind* of scale they are to fight and overcome.

They're put together only after a skilled chemist has determined by scientific analysis the exact nature and quantity of the scale-forming elements contained in the feed-water *you* use.

And then you get not only the right ingredients, but get them in the exact proportions to successfully meet *your particular case.*

That's why Bird-Archer Compounds never fail.

That's why.

That's why we say to you that you shall not pay us a cent until you *know* that Bird-Archer Compounds will do the work in *your* plant and that we have earned the money.

Send us a gallon of your feed-water today. We'll analyze it without charge and submit our proposition. Then, if it looks good to you, we will ship you the right stuff *on trial.*

Ask for a copy of our scientific treatise—"Boiler Troubles and Their Prevention." It is free, of course, but it's worth while.

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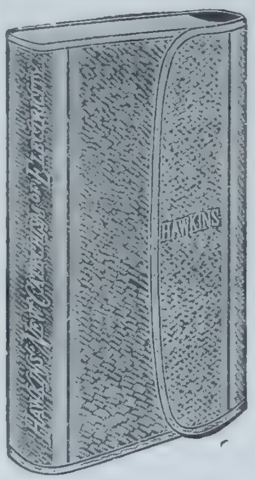
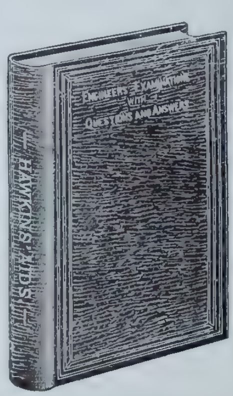


Hawkins' New Catechism of Electricity

It containe 550 pages with 300 illustrations of electrical appliances; it is bound in heavy red leather, with full gold edges and is a most attractive handbook for electricians and engineers. One third of the book is devoted to the explanation and illustrations of the dynamo, with particular directions relating to its care and management.—$2.00



Engineers' Examinations

By N. Hawkins, M.E.

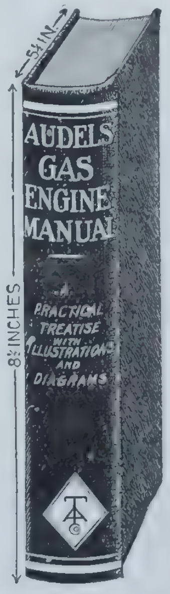
It presents in a condensed form the most approved practice in the care and management of steam boilers, engines, pumps, electrical and refrigerating machines, with examples of how to work the problems relating to the safety valve, strength of boilers and horse power of the steam engine and steam boiler.—$2.00.

Steam Turbines

By Leland.

A reference work on the development, advantages and disadvantages of the steam turbine; the design, selection, operation and maintenance of steam turbine plants and turbo-generators. 135 pages. Illustrated.—$1.00.

Audel's Gas Engine Manual



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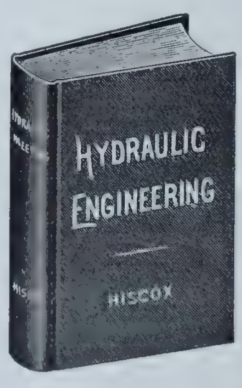

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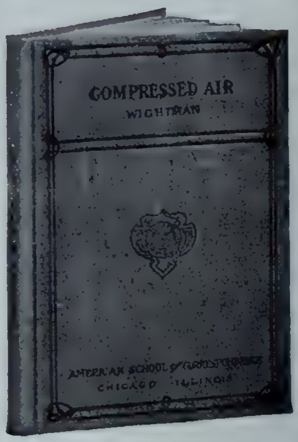

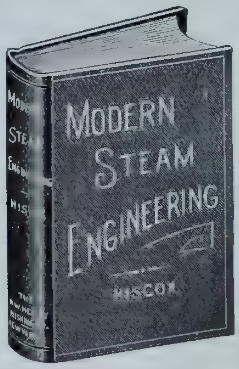

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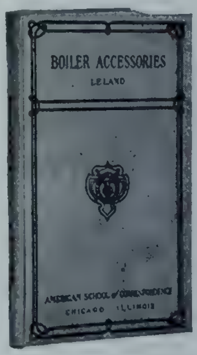

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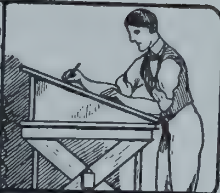

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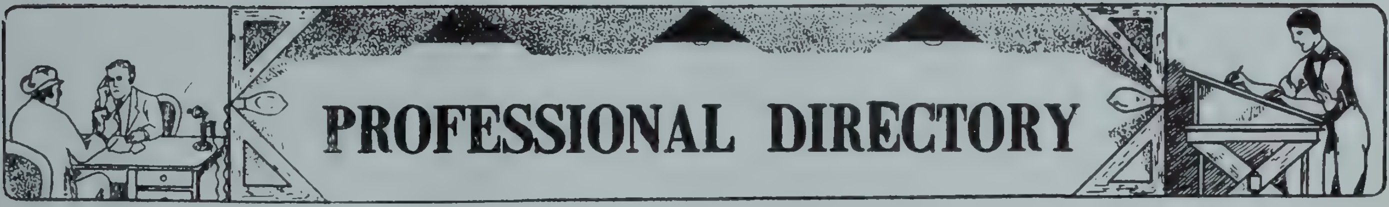

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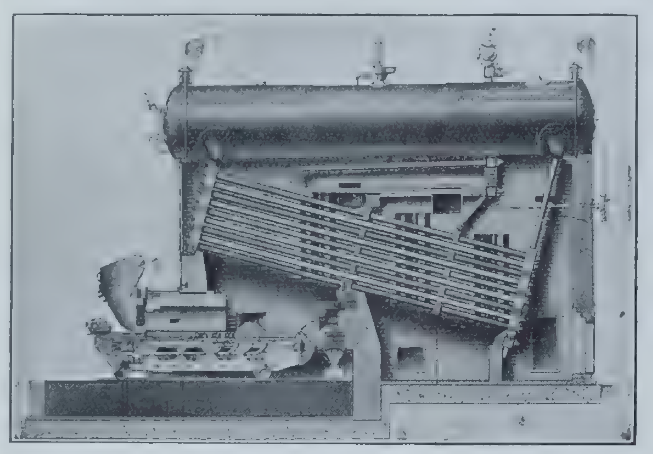

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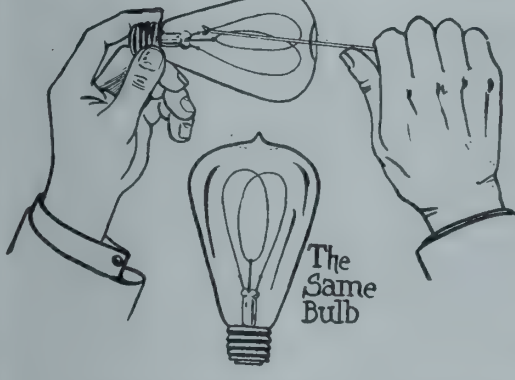

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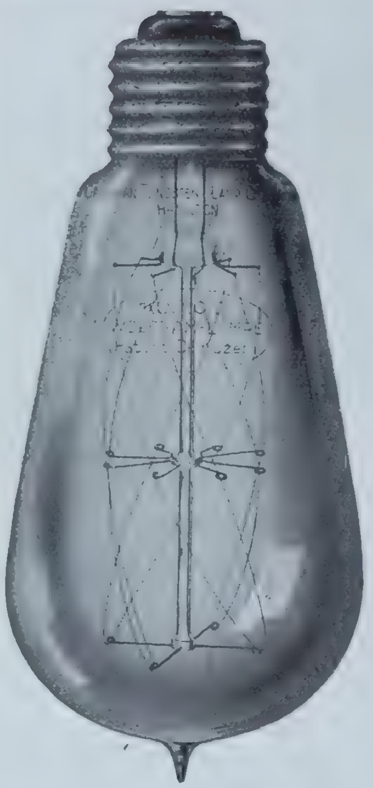

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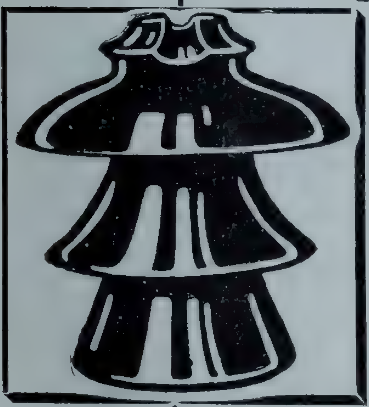

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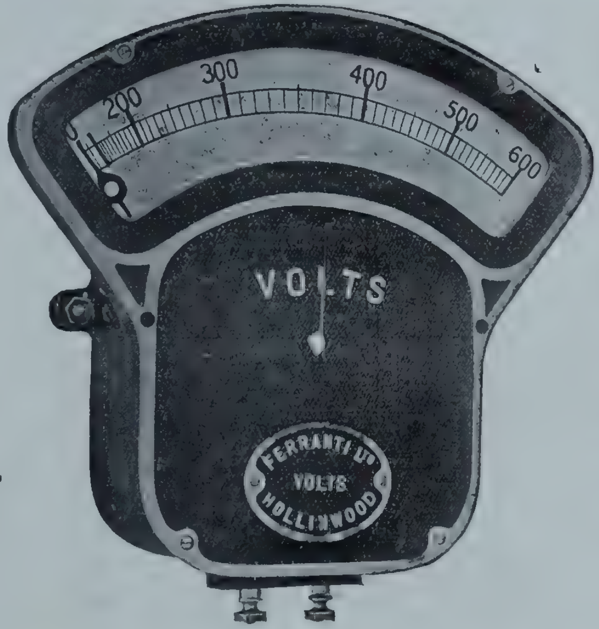

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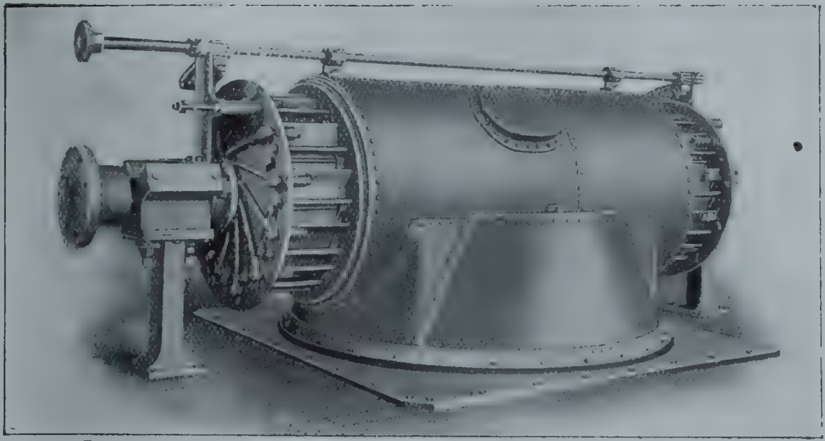

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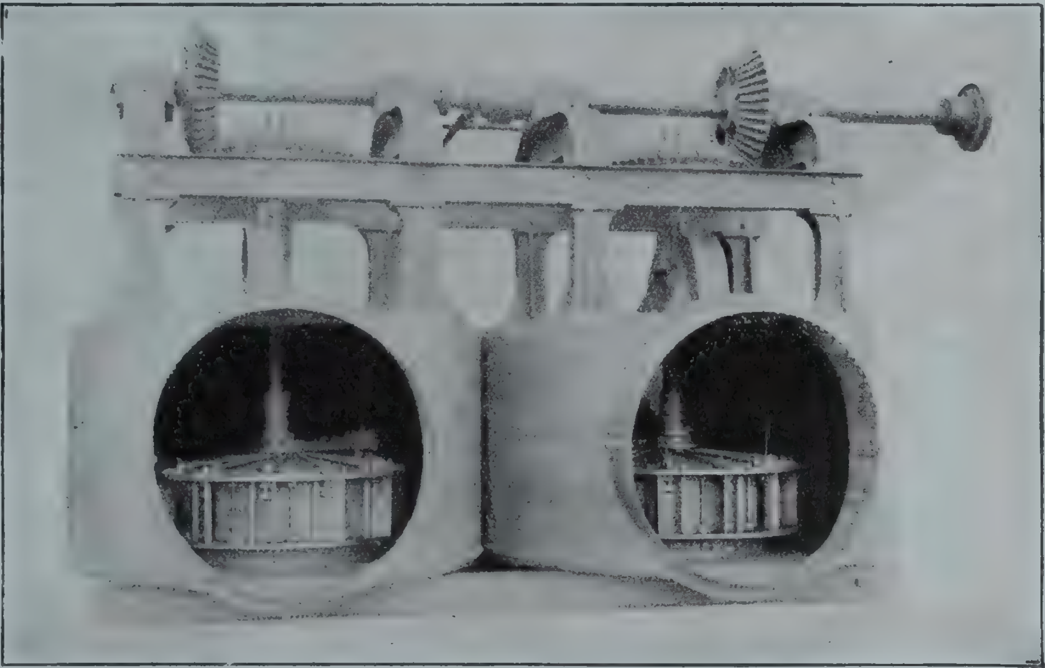

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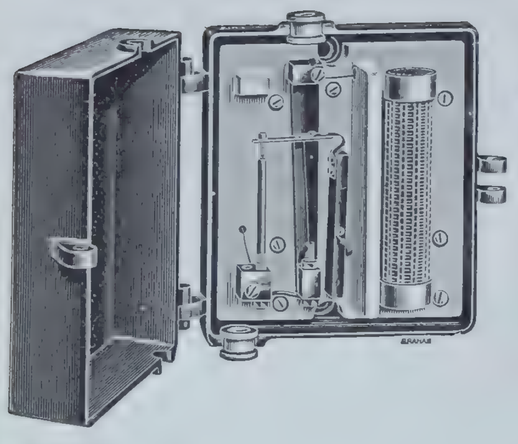

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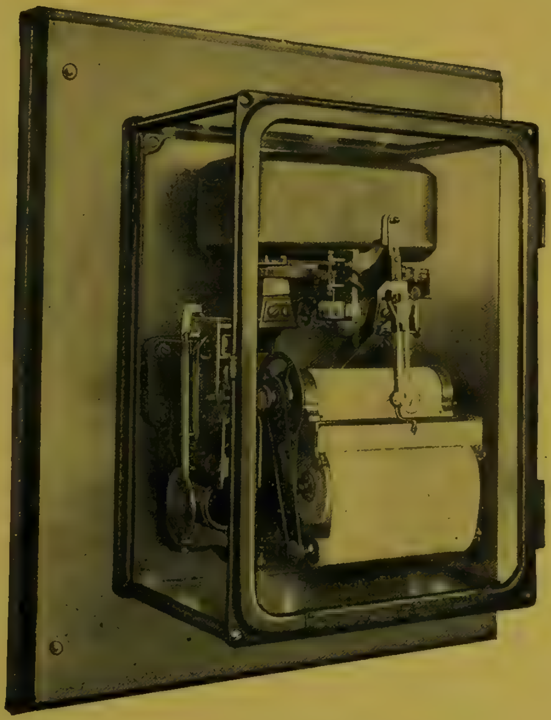

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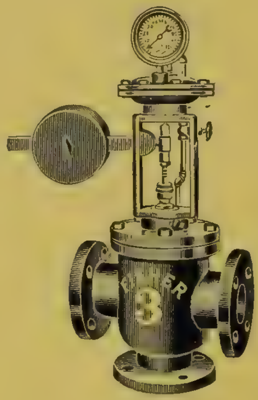

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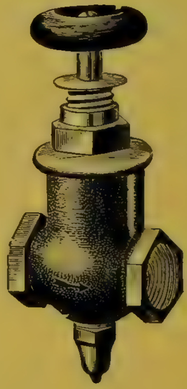

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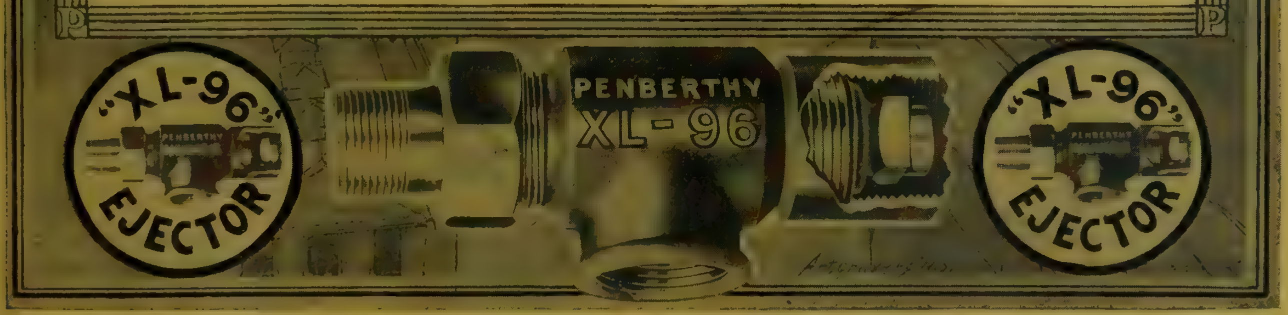

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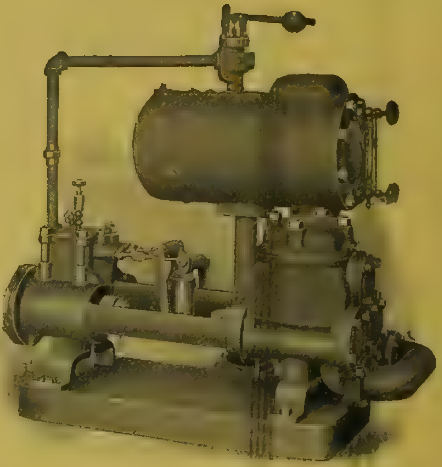

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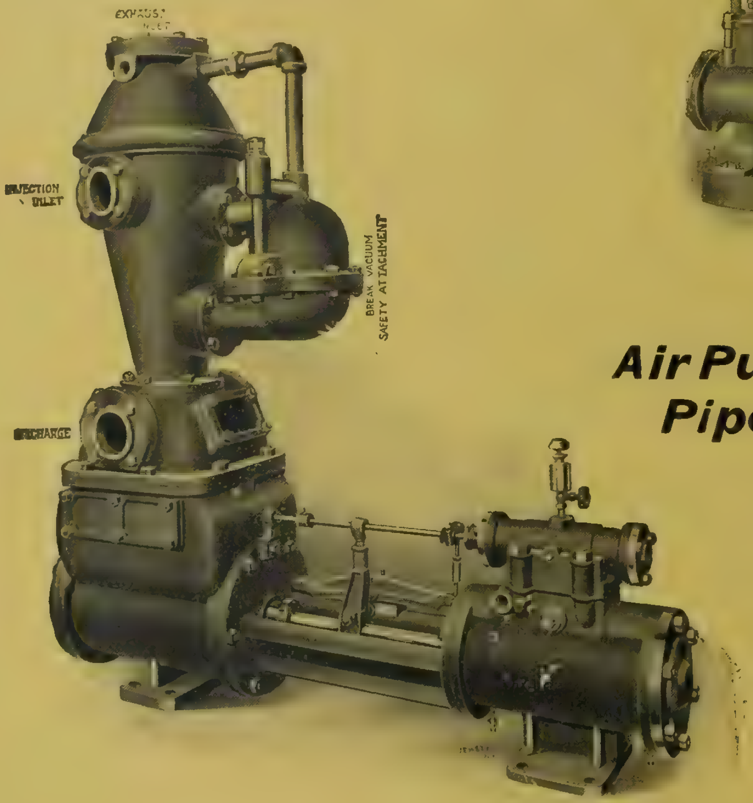

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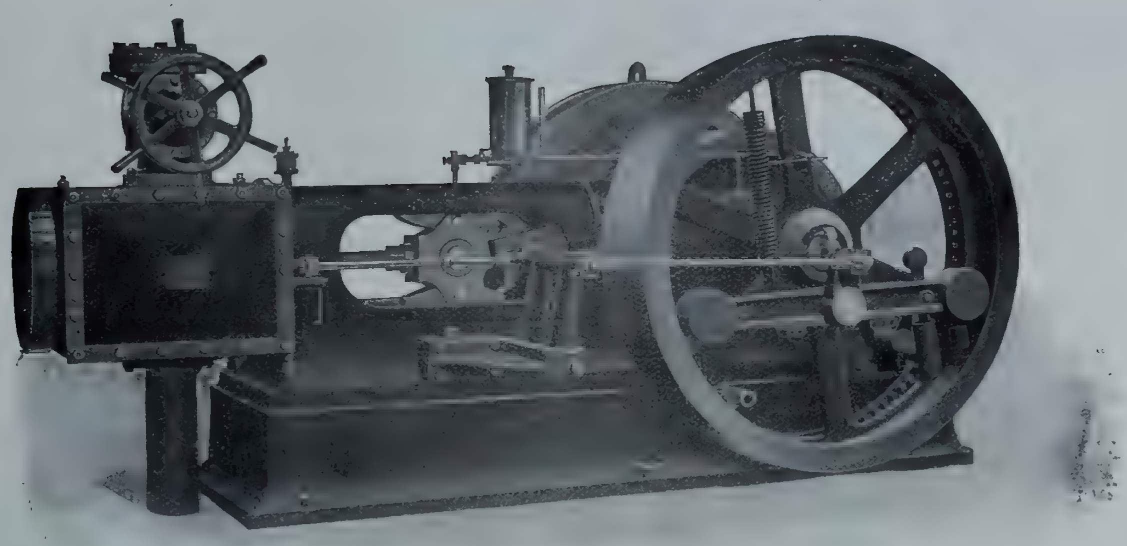

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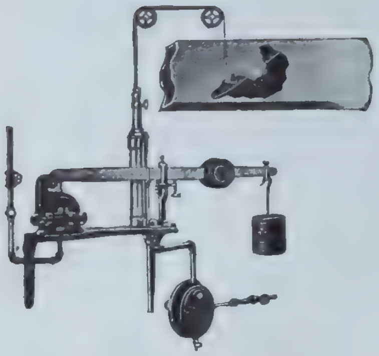
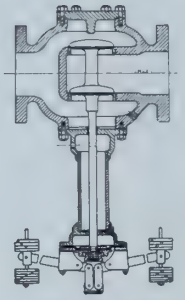
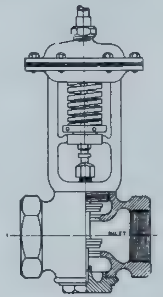


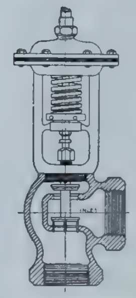
Lawrence Damper Regulator



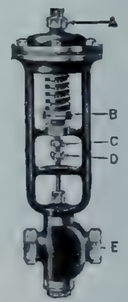
Lever Reducing Valve



Spring Reducing Valve



Pump Regulator



Fan Engine Regulator

Embodying, as they do, principles of correct design and accurate workmanship, these specialties are worth considering when in need of such. They will not fail at crucial moments, but continuously perform positive service. Get prices anyway, if only for sake of comparison.

Made by
Watts Regulator Co., Lawrence, Mass.
Sold in Canada by
Power Economies, Limited, 9 St. Nicholas Street **Montreal**

CYCLONE FANS

Embody Thirty Years' Experience in the

Design, Construction and Application

for all purposes, and therefore

Cannot be Approached for Efficiency and All Round Satisfaction

MATTHEWS & YATES Limited
Swinton, Manchester, Eng.

Agents for Eastern Canada: Bain & Mitchell, Y.M.C.A. Bldg., Montreal
Agents for Central Canada: Anglo-American Supply Co., Limited; 311 Enderton Buildings, Winnipeg

SMOKE CONSUMED IS FUEL SAVED

THE AUTOMATIC SMOKE PREVENTER SYSTEM causes smoke to be consumed and turned into valuable heat.

This system is the personification of symplicity. Oxygen is admitted into the fire-box when hydro and free carbons are being liberated from the fuel, causing them to ignite and generate intense heat instead of escaping unconsumed in clouds of smoke.

READ THIS LETTER:

> Messrs. Automatic Smoke Prevention Co.,
> 342 Craig Street, City.
> Dear Sirs,---In reply to your letter of the 6th inst., we beg to say that the three Smoke Consumers that you put under our boilers seem to give good satisfaction, and our engineer says he is very much pleased with them.
> Yours truly,
> The Thos. Davidson Mfg. Co., Limited
> T. Chas. Davidson, Vice-President.

First Order—August 30th, 1904
Second Order—July 9th, 1905
Third Order—Nov. 29th, 1905
Fourth Order—July, 1910

Now, write us about this system—don't delay. Write us NOW, asking for our free catalogue. It points the way to a big and permanent reduction of your fuel bills.

The **Automatic Smoke Prevention Co.**
342 Craig Street West, MONTREAL

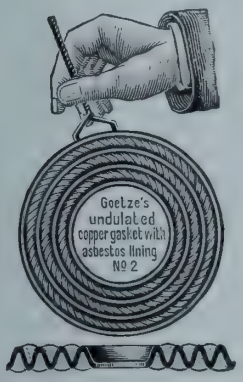
Are You Willing to Save Money?

Are you willing to be shown how to save money, so long as it doesn't cost you anything. Are you ready now? Then read below what Goetze's Pipe Gaskets and Goetze's Valve Gaskets will do for you, and remember as you read that we meet skepticism with proofs, at every point—that we place the proofs in your hands by sending you a supply of

Goetze's Copper Asbestos Gaskets On Ninety Days' Trial

entirely at our risk. Which means that you pay us no money till you know that you've got your money's worth—and more.

Goetze's Elastic Corrugated Copper Gaskets with Asbestos



Lining No. 2 are made for use in flange pipe joints—made to make such joints absolutely and permanently tight.

And they do just that, in spite of rough flange surfaces, highly superheated steam, highest steam pressures or long lines. They give you what is practically a continuous line of piping without joints, yet provide by their elastic corrugated construction, for all contraction and expansion.

Furthermore, instead of using two or three of them to each joint, as with the ordinary flat or thinly corrugated gaskets, you use only one of Goetze's Gaskets to each joint. That one does the business—for the corrugations spread or flatten just enough to bring the asbestos rings tightly against the pipe flanges, and nothing can get past those alternate walls of copper and asbestos.

You get those same copper-asbestos walls against the face of the opposite walls (Goetze's Gaskets being alike on both sides) and that gives you a joint that is a joint.

You don't have to follow them up or watch them. They not only make tight joints, but last for years, and can be used over and over.

That's the first lesson in saving.

Now make out your trial order and get the demonstration, right in your own plant. Remember—no cure, no pay.

Goetze's Copper Valve Gaskets with Asbestos Core

Goetze's-Valve-Gasket.

are made for valves of McAvity's Victor and Jenkins types.

They not only insure longer life to new valves, but will enable you to renew the youth of many an old valve, and even to reclaim some of those which have been consigned to the scrap heap.

And, besides, they save a lot of time in renewals—they last so.

You see, this clever combination of elastic copper and asbestos forms a cushion which yields but doesn't crush—a cushion on which the valve seats will close tightly, without injury to it or to themselves. And that spells freedom from leaks, waste and rapid deterioration.

There are plenty of things that rubber is good for, but valve gaskets is not one of those things, and you'll never use another rubber gasket (or any other kind for that matter) after you've tried Goetze's Copper Valve Gaskets.

They're applied without removing valves from the piping, and if you're going to use them with acids and such, we'll furnish them of Nickel and asbestos.

This, then, is the second lesson in saving.

And, as with Goetze's Pipe Gaskets, we ask you to make up your trial order at once so that you may see this lesson demonstrated in your own valves.

Goetze Gaskets are carried in stock by

T. McAVITY & SONS, LIMITED

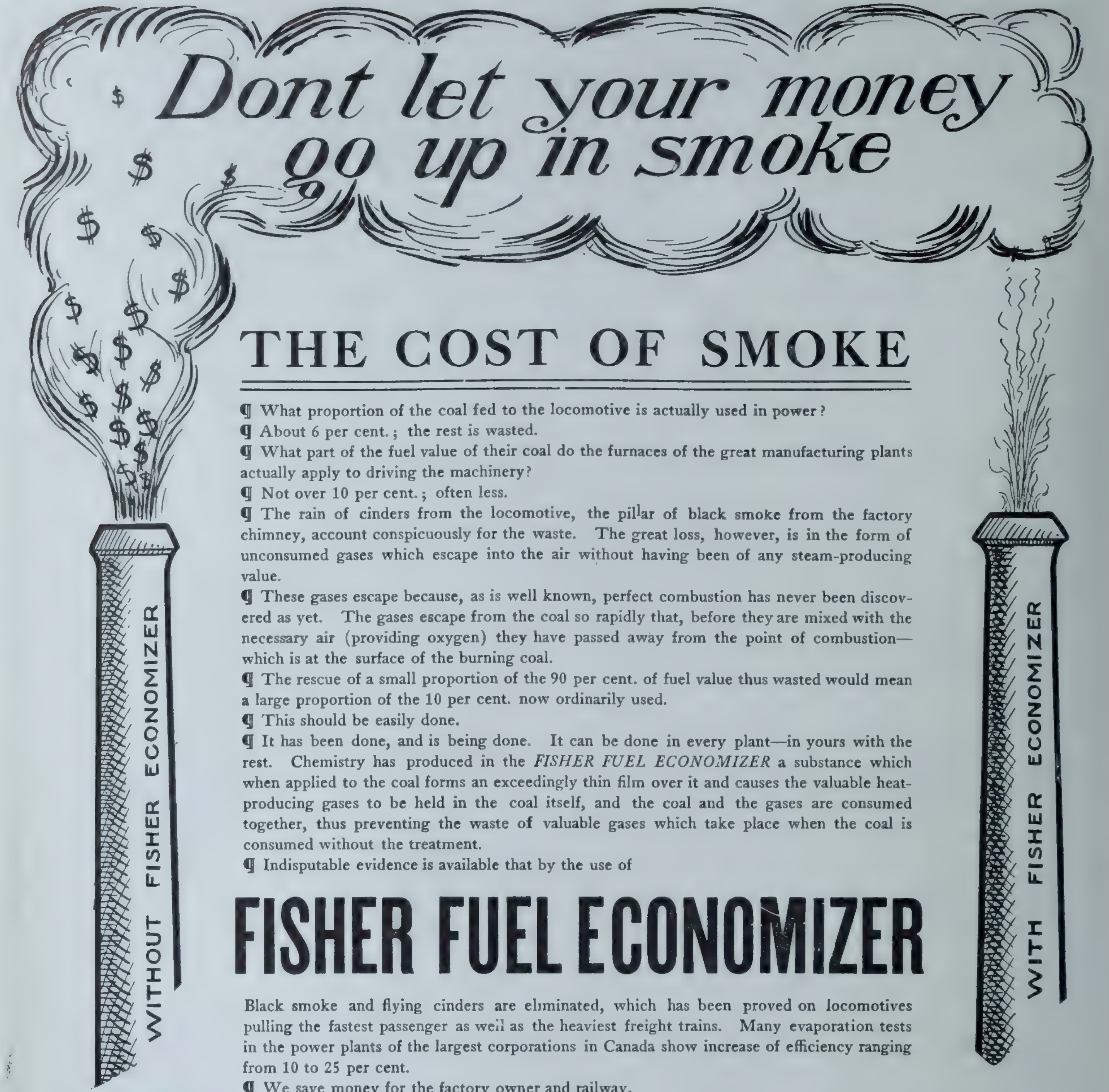
St. John, N.B.

BRANCHES AT

MONTREAL	TORONTO	WINNIPEG	VANCOUVER
163 Esplanade Ave,	404 McKinnon Bldg.	Box 331	c/o A. O. Campbell

MANUFACTURED BY

American Goetze-Gasket & Packing Co.,
NEW BRUNSWICK, N.J.



THE COST OF SMOKE

¶ What proportion of the coal fed to the locomotive is actually used in power?

¶ About 6 per cent.; the rest is wasted.

¶ What part of the fuel value of their coal do the furnaces of the great manufacturing plants actually apply to driving the machinery?

¶ Not over 10 per cent.; often less.

¶ The rain of cinders from the locomotive, the pillar of black smoke from the factory chimney, account conspicuously for the waste. The great loss, however, is in the form of unconsumed gases which escape into the air without having been of any steam-producing value.

¶ These gases escape because, as is well known, perfect combustion has never been discovered as yet. The gases escape from the coal so rapidly that, before they are mixed with the necessary air (providing oxygen) they have passed away from the point of combustion—which is at the surface of the burning coal.

¶ The rescue of a small proportion of the 90 per cent. of fuel value thus wasted would mean a large proportion of the 10 per cent. now ordinarily used.

¶ This should be easily done.

¶ It has been done, and is being done. It can be done in every plant—in yours with the rest. Chemistry has produced in the *FISHER FUEL ECONOMIZER* a substance which when applied to the coal forms an exceedingly thin film over it and causes the valuable heat-producing gases to be held in the coal itself, and the coal and the gases are consumed together, thus preventing the waste of valuable gases which take place when the coal is consumed without the treatment.

¶ Indisputable evidence is available that by the use of

FISHER FUEL ECONOMIZER

Black smoke and flying cinders are eliminated, which has been proved on locomotives pulling the fastest passenger as well as the heaviest freight trains. Many evaporation tests in the power plants of the largest corporations in Canada show increase of efficiency ranging from 10 to 25 per cent.

¶ We save money for the factory owner and railway.

¶ We save the fireman much hard and dirty work.

¶ We save the black smoke which pollutes the air.

¶ We reduce your ashes and clinkers half.

¶ We increase and maintain steam to a degree which is impossible without the economizer.

¶ We keep your boiler tubes and grate bars clean, reducing expense of upkeep.

Let Us Prove It to You. Write To-day for Information

Phone Main 2390

Fisher Fuel Economizer Limited

Head Office, 74 Bay St., Toronto, Ont.

MONTREAL
Gerald Rowe, 187 McGill Street
Phone Main 811

OTTAWA
569 O'Connor Street
Phone 4494

WINNIPEG
310 McGreevy Block
Phone Main 2750

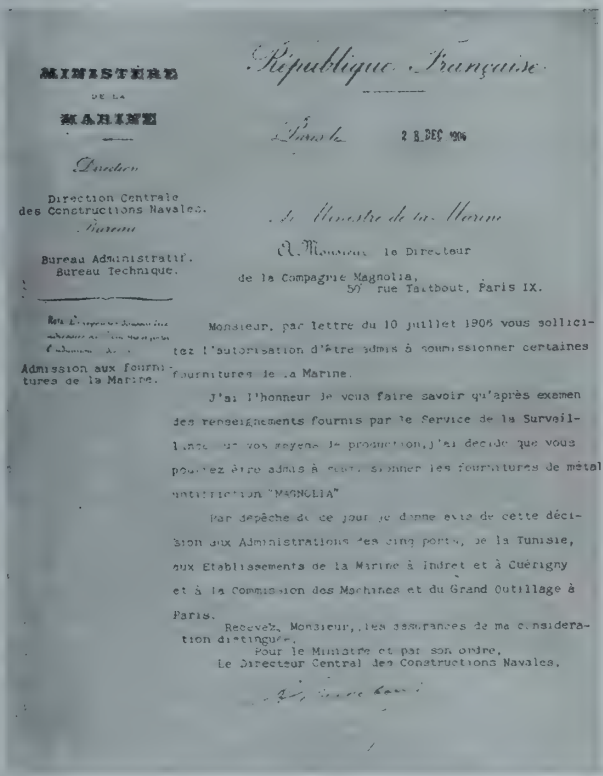
TRADE MARK

Test No. 783 by the Research Laboratory of the French Government

THESE TESTS WERE DIVIDED INTO THREE SECTIONS

1st. Determination of the co-efficients of friction under varying pressures.
2nd. Determination of temperatures under different Velocities: "Endurance Test."
3rd. Determination of the rate of wear.

Reports of these tests were accompanied by fourteen tabulations and the results were so highly favorable to Magnolia Metal, sustaining in every particular its well-known qualities, that the following letter was written by order of the Minister of Marine, approving of the use of Magnolia Metal by the French Navy. No people surpass the French in scientific knowledge and highly technical painstaking investigation, and their endorsement of Magnolia Metal is another strong link in the chain of evidence that we are able to furnish:



MINISTÈRE
DE LA
MARINE

Direction

Direction Centrale
des Constructions Navales.

Bureau

Bureau Administratif.
Bureau Technique.

Admission aux fournitures de la Marine.

République Française

Paris le 28 DEC 1906

Le Ministre de la Marine

A Monsieur le Directeur
de la Compagnie Magnolia,
50 rue Taitbout, Paris IX.

Monsieur, par lettre du 10 juillet 1906 vous sollicitez l'autorisation d'être admis à soumissionner certaines fournitures de la Marine.

J'ai l'honneur de vous faire savoir qu'après examen des renseignements fournis par le Service de la Surveillance sur vos moyens de production, j'ai décidé que vous pourrez être admis à soumissionner les fournitures de métal antifriction "MAGNOLIA"

Par dépêche de ce jour je donne avis de cette décision aux Administrations des cinq ports, de la Tunisie, aux Etablissements de la Marine à Indret et à Guérigny et à la Commission des Machines et du Grand Outillage à Paris.

Recevez, Monsieur, les assurances de ma considération distinguée.

Pour le Ministre et par son ordre,
Le Directeur Central des Constructions Navales.

TRANSLATION

The Director of the Magnolia Co.
50 Rue Taitbout, Paris ix

Sir:—

By yours of July 10th, 1906, you request permission to be allowed to furnish certain Navy Supplies.

I have the honor to inform you that after examination of the information furnished by the Service de la Surveillance regarding your method of production, I have decided that you may be allowed to furnish the supplies of Magnolia Anti-friction Metal.

By telegram of this day I transmit this decision to the Administrations of the five ports, of Tunisie, to the Navy Department of Indret and Guerigny and to the Commission of Machines et du Grande Outillage at Paris.

Receive, sir, the assurance of my distinguished esteem.

For the Minister and by his order.
The Central Director of Naval Construction.

A. DUDEBOUT.

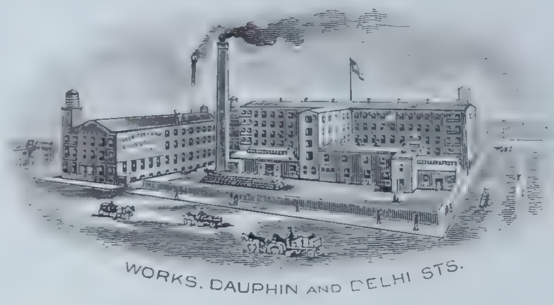
SOLD BY LEADING DEALERS EVERYWHERE OR BY

MAGNOLIA METAL CO.

No. 225 St. Ambroise Street. MONTREAL

New York — Chicago — San Francisco

SPECIAL OFFER PRACTICAL ENGINEER POCKET BOOK, containing 680 pages, treating on over two thousand Engineering and Mechanical Subjects, brought up to date. We offer this valuable reference work at 40c postage prepaid. Address Montreal office.


WORKS, DAUPHIN AND DELHI STS.

MADE BY US NOT FOR US

THERE'S just the difference; it looks small in words, but it means everything to you. Every detail of the work from analyzing to manufacturing is carried on in our own factory and under our personal supervision, which insures your receiving full value for your money and the proper "cure" for your boiler troubles.

Only the best of chemicals are allowed to enter into the composition of Lord's Water Purifying Chemicals.

Every sample of water or scale is subjected to a most careful analysis in our laboratories before any attempt is made to prescribe for it. Being specially equipped for this class of work and with an experience of almost fifty years, is why Lord's Boiler Compounds are the World's Standard.

Write us about your boiler troubles; send us a sample of scale or water for analysis and get a valuable report on it, with the terms of our free trial offer.

Our booklet, entitled, "BOILER TROUBLES, AND THEIR TREATMENT," is free for the asking.

Geo. W. Lord Co.

2238-50 North Ninth Street
PHILADELPHIA, Pa.

Agents wanted in the various cities of Canada

Scale Permanently Removed —or money refunded

In a nutshell that's our way of doing business. And we never could afford to do business under such a hard and fast guarantee unless we were certain our compound would always do its work.

But we know that

Walker's Electric Boiler Compound

will *always* do what we claim. So we run no risk. And this is our claim: That the regular use of Walker's Electric Boiler Compound will keep your boilers free from scale without the least injury to your boilers, pumps or any other part of your plant.

Could anything be more emphatic?

Write for our price list.

THE ELECTRIC BOILER COMPOUND CO., LTD.
GUELPH, ONTARIO

ALSO

OILS For Engines, Machines Cylinders Dynamos and all other Engine Room **SUPPLIES**

Specialty: Pure Tri Sodium Phosphate.

Dont Waste Time

or expense cleaning scaly tubes! any money spent in preventing scale is a far more profitable outlay than what it costs to remove the scale after it has formed. Prevent scale by using

INTERNATIONAL BOILER COMPOUND

But we can't work in the dark; we must find out what your feed water contains before we can mix the compound that will eliminate the scale-forming salts. Express us one gallon of your feed water; we will analyse it *free of charge*, and will forward a TRIAL SAMPLE of our compound guaranteed to banish all your Scale Troubles.

You can make money acting as our agent. Write for details of our offer.

Get in touch with us to-day.

International Boiler Compound Company

144-146 West Michigan St., Chicago, Ill., U.S.A.

THE BIRD-ARCHER COMPANY'S
90 WEST ST.
TRADE MARK
NEW YORK
BOILER COMPOUNDS

You Know What Scale Does to Your Boilers and Your Coal Pile

and the time and temper of everybody around the place. We don't need to tell YOU anything about that. BUT—

Do You Know what Bird-Archer Boiler Compounds Do to Scale?

They simply put it out of business—and keep it out.

They don't get it out in a minute—anything that will do it that quick will put your boiler to the bad.

They get it out by softening and disintegrating it—gradually, but surely and safely.

They do this work thoroughly because we do our work that way—*because we do not send you our Compound till we know the work it is to do, and then we send the combination that will do the work.*

We find out what to send by making a thorough analysis of your feed water, and *the Compound we send is put up for your particular case.*

There isn't a thing in it that is bad for your boiler. There isn't a thing in it that isn't "bad" for scale. Scale and Bird-Archer Boiler Compounds will not stay in the same boiler—the Compound stays after it has "ousted" the scale and keeps new scale from forming.

Send a gallon of your feed water to our Montreal agents. They'll analyze it and send you a "made-for-you" Compound that will banish your scale, pitting and corrosion troubles for good.

Not a cent to pay if it doesn't do the work to *your entire satisfaction.*

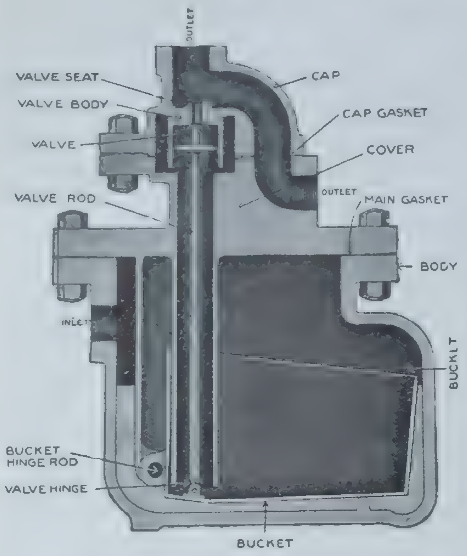
Write for our scientific treatise on "Boiler Troubles and Their Prevention." Unlike most things that are free, it is valuable, and it is not "all advertising."

The BIRD-ARCHER COMPANY

90 WEST STREET, NEW YORK CITY

Canadian Representatives: Lowden & Mead, 13 Bleury Street, Montreal

There are three kinds of Steam Traps—GOOD, BAD and INDIFFERENT.



GOOD traps save your steam.

BAD traps waste steam.

INDIFFERENT traps save some of the steam and waste the balance.

You will find

Strong Steam Traps

in the first class. You can find this out for yourself without any possibility of a loss by sending us an order for one or more traps for 60 days' trial. If you don't like them, send them back at our expense, and just remember that on their merits alone we ask your patronage.

Registered

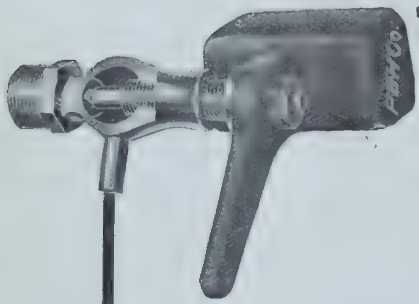
4/S

Trade Mark

The Canadian Fairbanks Co., Limited

Montreal, Quebec, Canada

TORONTO ST. JOHN, N.B. WINNIPEG CALGARY VANCOUVER



Don't look for trouble!

There's plenty around without seeking it! The devices illustrated will save trouble in every Boiler Room, and should surely find a place in YOUR plant.

The "P.B.H." Quick-Opening, Self Closing Gauge Cock

remains leakless for years. Simple, efficient, quickly repaired and economical.

The "Tornado" Steam Boiler Tube Cleaner

carries no moisture to wet soot and blows through the longest tubes. Works thoroughly, rapidly and economically.

The "P.B.H." Quick-Closing Water Gauge

shuts off steam and water, in case of a broken glass, by a pull of the chain. A perfect insurance against burns and scalds.

Any of these devices willingly sent on trial.

The Paul B. Huyette Co., Inc.

1414 Betz Buildings

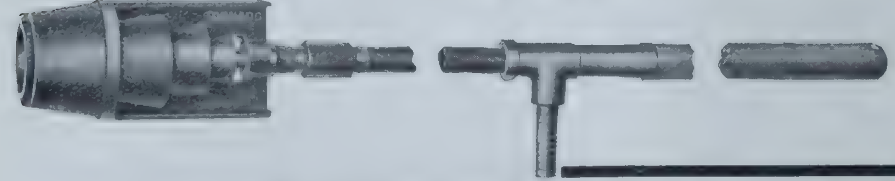
PHILADELPHIA, Pa., U.S.A.

WRITE FOR CATALOGUE

Selling Agents for Western Ontario and North-West: Canadian Steam Boiler Equipment Co., 186 Queen St. E., Toronto

Selling Agents for Province of Quebec and Eastern Ontario: H. L. Peiler & Co., 52 St. James St., Montreal, Canada

Selling Agents for Maritime Provinces and Newfoundland: H. L. Peiler & Co., Moncton, N.B.



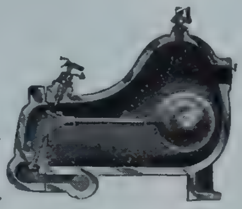
McDANIEL IMPROVED STEAM TRAP

FOR HIGH OR LOW PRESSURE.

Steam can't blow through. They have large discharge valves and cannot be flooded from sudden flushes of water.

MAY WE SEND ONE FOR TRIAL?

Reducing Valves, Pump Governors, Relief Valves, Exhaust Pipe Heads, Ejectors and Steam Separators. SEND FOR CATALOGUE.



THE GARTH COMPANY
26 Craig St., MONTREAL, CAN.

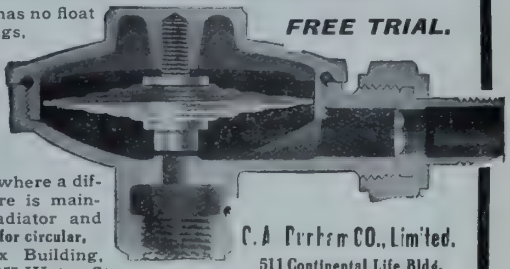
IDEAL STEAM SEPARATOR & SUPPLY CO.
820 Euclid Ave., ONTARIO, CAN.

TEST IT AT OUR EXPENSE!

We are so satisfied about the excellence of the

DUNHAM RADIATOR TRAP

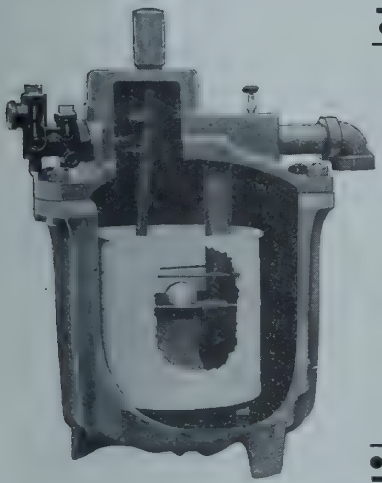
that we will willingly send you one on ***thirty days' FREE TRIAL.***



The "Dunham" has no float or expansion plugs, passes air or water through rapidly, but is instantly closed by steam.

Unequalled for use on the return end of radiators, where a difference of pressure is maintained between radiator and return pipe. **Write for circular.** Branches—Phoenix Building, Winnipeg, Man.· 157 Water St., Vancouver, B.C.

C. A. Dunham CO., Limited.
511 Continental Life Bldg.
TORONTO



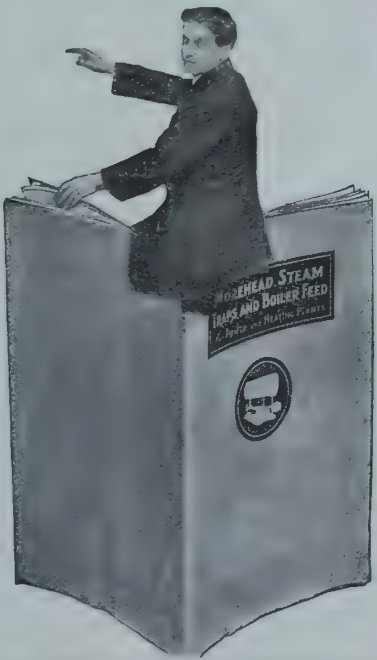
THE ALBANY
STEAM TRAP

Will solve the problem for you. Backed by over 40 years' trap experience. Get in touch with the makers:---

The Albany Steam Trap Co.
ALBANY, N.Y.

The Book that Answers the Condensation Question

WHAT method are you using to drain your steam systems? Is it simple, economical and reliable? If there is quite some condensation does it return it to the boilers as feed water? This is the method you should use and this free book will tell you all about it. It concerns the Morehead Tilting Return and the Morehead Tilting Non-Return Steam Trap.



The Morehead Steam Trap

The Morehead Return Trap not only drains the steam lines effectively, it returns the condensation together with sufficient water from your heater to the boilers. It acts as a reliable boiler feed.

"We were wasting a great deal of steam through condensation," writes a customer, "and in looking around for something to return the hot water to the boiler, decided on a Morehead Trap. It has been in constant use for five years, yet we have spent but five dollars for repairs, and all the attention it requires is packing occasionally."

Why not send for this free book to-day? It contains many an idea of practical value to you. *Write.*

Morehead Manufacturing Co.
Dept. "J" DETROIT, MICH.

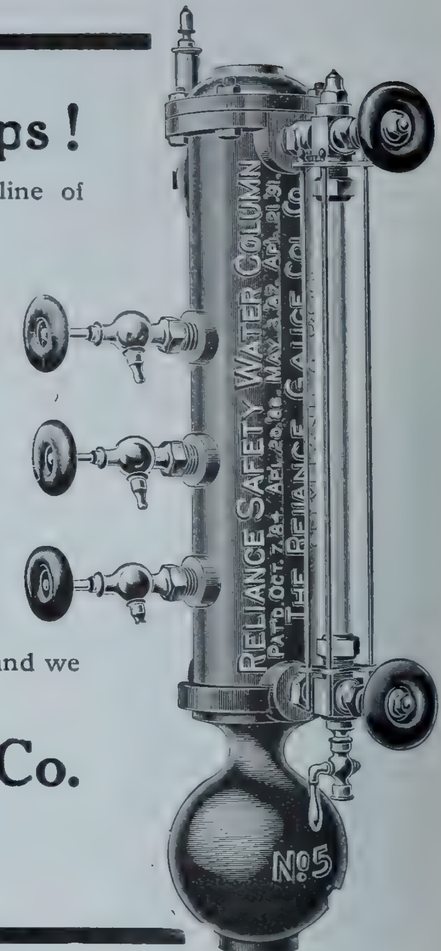
Canadian Representatives: A. R. Williams Machinery Co., Toronto; Lowden & Mead, Montreal, Que.; Park Bros., Chatham, Ont.

The watchman that never sleeps!

Your fireman is only human, and may easily allow the water line of your boiler to get too high or too low. But the

"RELIANCE"

Safety Water Column


RELIANCE SAFETY WATER COLUMN
PAT'D OCT. 7, 84. APR. 28, 91. MAY 3, 92. APR. 21, 91.
THE RELIANCE GAUGE CO.
No5

never fails in its duty, and compels the water to be carried constantly at its economical level.

The "Reliance" eliminates waste of fuel, creates steady power, and gives remarkable safety from explosion.

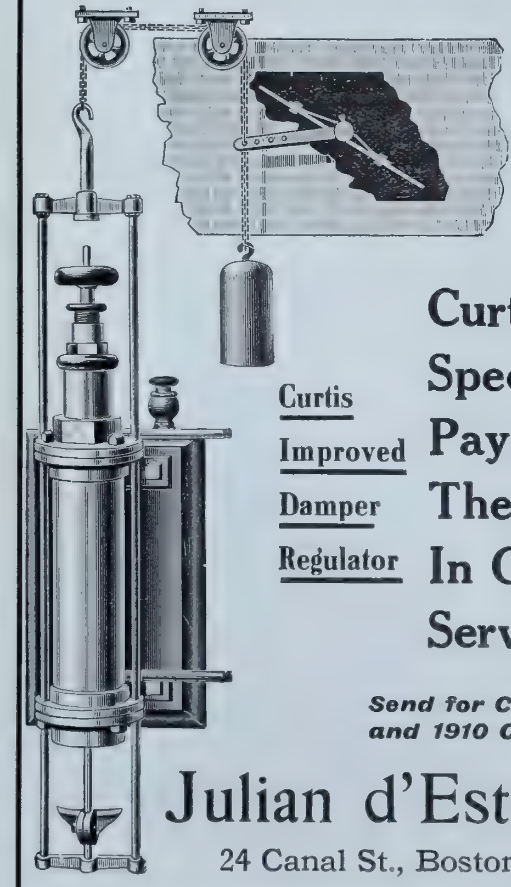
It operates automatically, requires no attention and gives an immediate and distinct alarm signal long before the danger point is reached.

Write us, if your boilers are not equipped with the "Reliance," and we will make you an offer.

The Reliance Gauge Column Co.

5902 Carnegie Avenue, Cleveland, Ohio.

Also makers of "Reliance" Steam Traps, "Reliance" Lever Water Gauges, "Reliance" Lever Gauge Cocks.



CURTIS

Engineering Specialties

Curtis Improved Damper Regulator

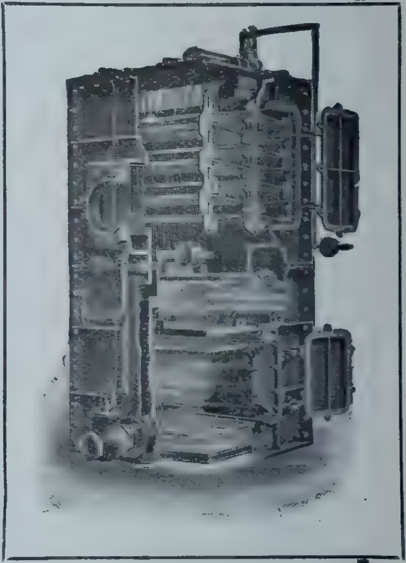
Curtis Specialties Pay for Themselves In Good Service

Send for Circular and 1910 Catalog

Julian d'Este Co.

24 Canal St., Boston, Mass.

More Power at Less Cost!



Here's a proposition to diminish working costs that must surely appeal to YOU!

Will you investigate the merits of the

WEBSTER

Feedwater Heater, Purifier and Filter?

It makes use of all condensations and waste steam, and will positively rid your boiler of scale by removing all scale-forming elements from your feedwater. Using pure water means getting every ounce of power out of your boiler with a *smaller* amount of fuel.

Our descriptive literature has many points of interest for you! Send for it TO-DAY.

DARLING BROS., LIMITED

Montreal Toronto Winnipeg

Vancouver, B.C., Frank Darling, Agent

Typical samples of condensed exhaust steam before and after filtration through a Blackburn-Smith Filter.

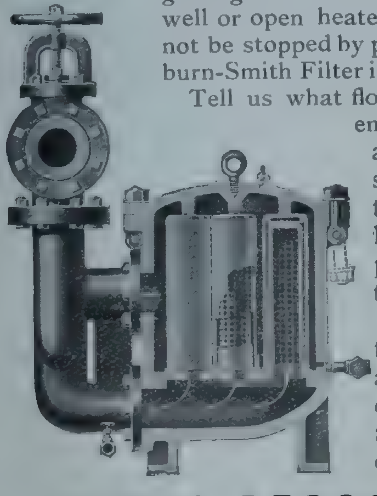
Real Protection from Oil and Other Floating Articles

demands filtration of both the condensation and the make-up water. Line separators and the separating devices on open heaters never remove *all* the oil before condensation of the exhaust, and no charcoal or excelsior bed in any heater can be depended upon for complete elimination of floating particles. There is no better medium than terry cloth for filtering out the impurities and there is no better way of using the terry than in The *Blackburn-Smith Feed Water Filter and Grease Extractor.*

This apparatus has stopped the troubles in many plants where other eliminating and filtering devices failed completely. The double separated terry cloths can be renewed in a few minutes when foul and the change involves no boiler shutdown or hard work for the engineer. If oil or other floating particles now get in your boilers you can profit by trying one of these filters. We have yet to find where oil getting into boilers from the hot well or open heater chamber cannot be stopped by putting a Blackburn-Smith Filter into the feed line.

Tell us what floating impurities enter your boilers, and we will show you how the trouble can be stopped on profitable terms to yourself.

Ask for our trial proposition and a copy of our book, "Filtration of Boiler Water."



JAMES BEGGS & CO.

39 Warren St., New York.

Sole Canadian Sales Agents:

EADIE-DOUGLAS, Limited

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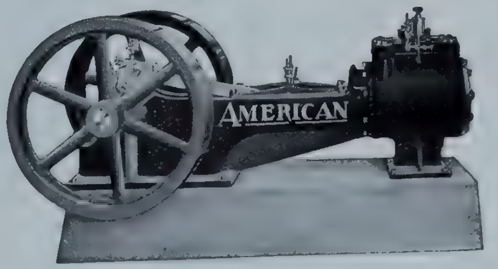

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By its use is obtained the *minimum* amount of *friction*, and the *maximum* amount of *wear*. It is self-lubricating to a great extent. It will *not* become hard. It works equally well on heavy mining pumps, and the most sensitive valve stems. It is a perfect preventative against loss of ammonia in ice machines.

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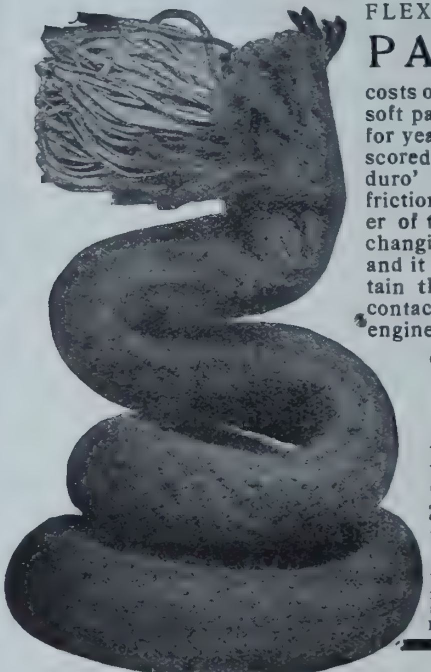

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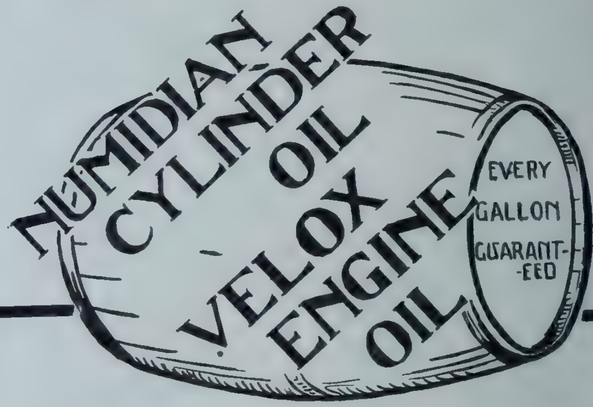

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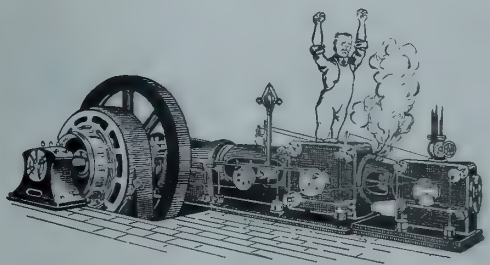

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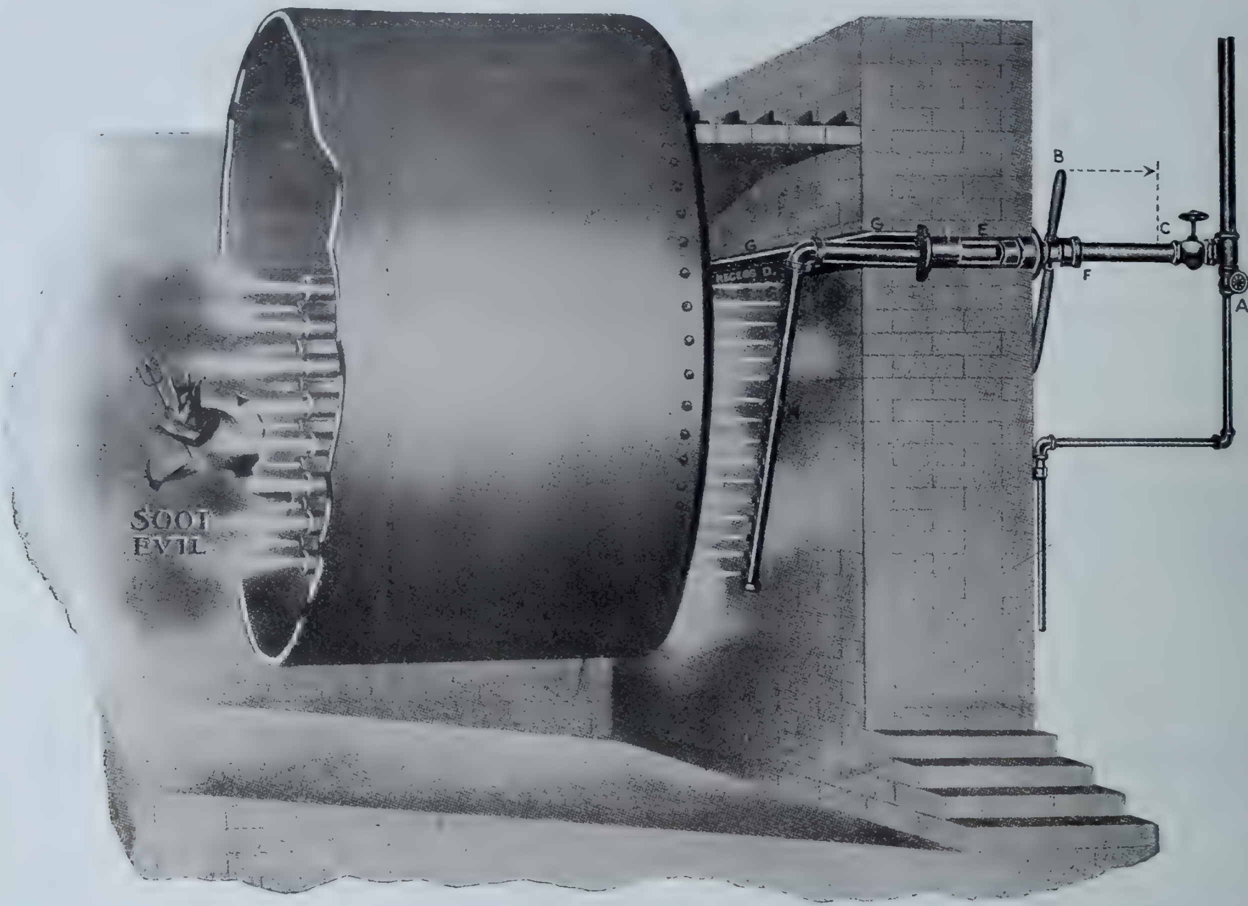

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as applied to the REAR END of a Return Tubular Boiler, throws direct concentrated blasts of dry steam into each tube and ***blows with the draft, while the smoke box doors remain closed. It will not burn out. This we guarantee.***

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Dear Sir,—We are pleased to state that we would not be without the Vulcan Soot Cleaners installed by you. The saving is great, both in labor and fuel. Yours truly

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They congratulate those Wise Engineers who have installed the 'Cyclone,' on their freedom from furnace worries, and they hope, during the coming year, to gather within the fold those who are not already using this celebrated grate.

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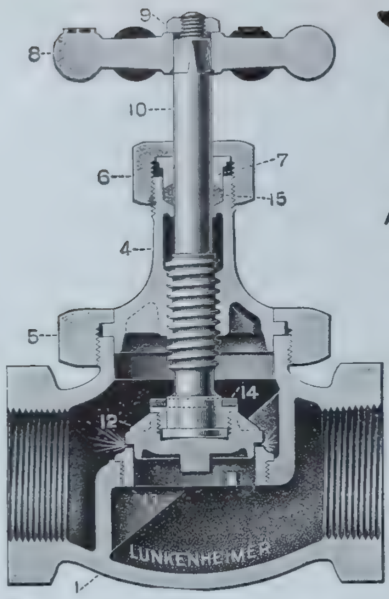

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ARE POSITIVELY THE MOST DURABLE AND PRACTICAL MADE

THE SEATING SURFACES CAN BE RE-GROUND and ALL PARTS SUBJECTED TO WEAR CAN BE RENEWED, including the DISC and SEAT. The SEAT is SELF-CLEANSING and is made of a hard, close-grained nickel.

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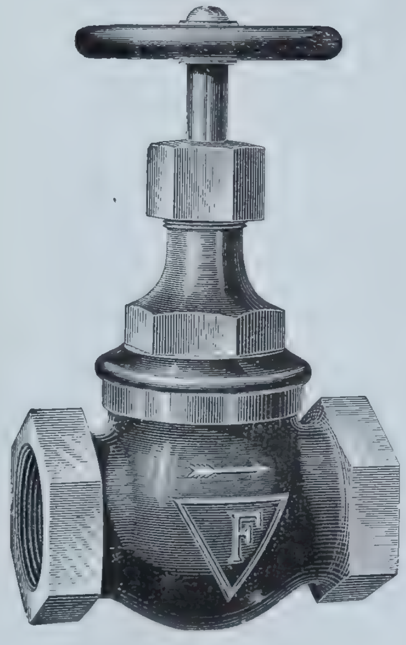
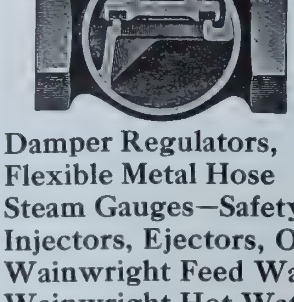


Pressures, 125-175-250 lbs.

Fairbanks' Renewable Disc Valves

are well and simply made and have many excellent features. They are tight and remain tight under the most severe service. The disc is loose on the spindle, allowing it to come to an even bearing on the seat, and it can be easily replaced in a few minutes, making the valve as good as new. The valves are heavy and doubly strong, owing to correct distribution of metal.



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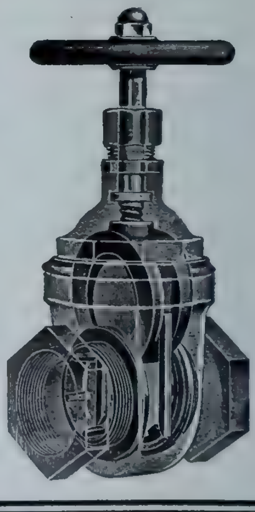

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Type "K"

IRON BODY BRONZE MOUNTED

Gate Valves

Tested to 300 pounds hydraulic pressure.

Elliptical in design.

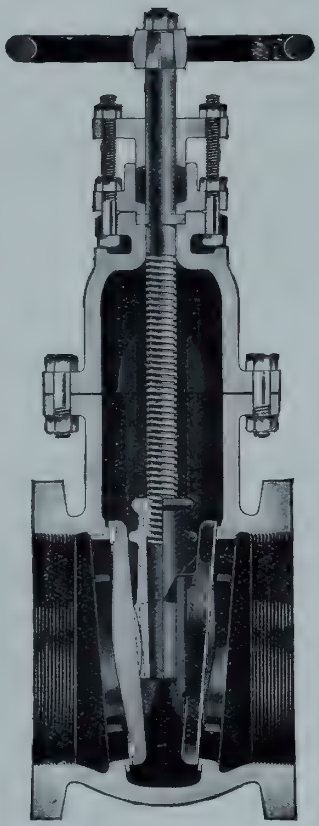
Double Compensating Bronze Faced Discs.

Can be re-packed while under pressure and wide open or closed.

Parts interchangeable.

Discs cannot jam.

Possess wide margin of safety.



Suitable for 125 pounds working steam pressure.

Design insures great rigidity and strength.

Heavy bronze seat-rings screwed into body and renewable.

Bronze disc-rings forced into double-grooved recesses in discs.

Can be operated in any position.

Handsome appearance.

Dependable in service.

A Thoroughly Reliable Gate Valve

A comparison with other Gate Valves is invited as regards design, material, workmanship and price

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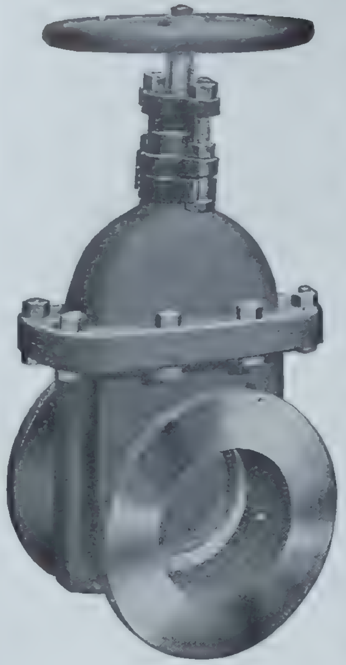

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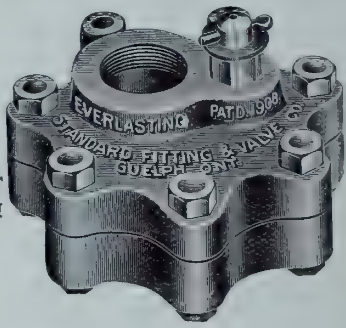
Give us a chance to prove it.



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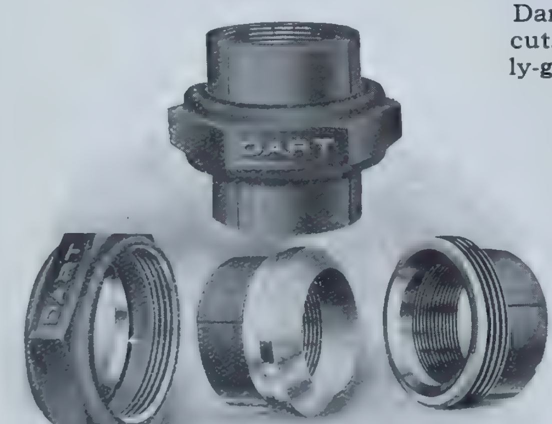
An acquaintance with Dart Unions leads to the abolition of ALL the troubles and expense due to leaky pipe joints. Both sections of a Dart Union, as shown in the cut, are seated with smoothly-ground bronze.



When connected they make a ***bronze-to-bronze ball joint that cannot rust or corrode and that is perfectly tight against steam, air, gas, oil and water.***

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ASK YOUR DEALER FOR DART UNIONS.

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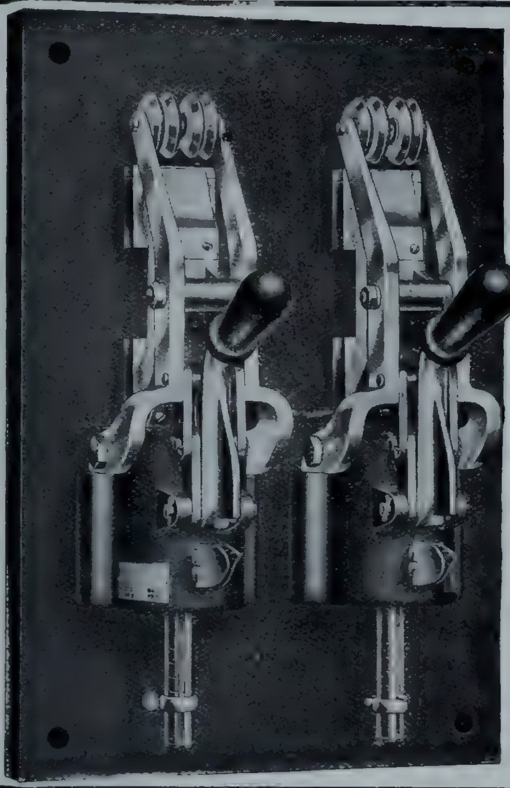

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Condit Circuit Breakers are always so arranged that one pole cannot possibly be opened without the opening of all poles, and so that each pole is protected by its own coil---the only combination which will give absolute protection.

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These, together with reasonable cost, have established the reputation of

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Reilly Multicoil Feed Water Heaters, Condensers and Evaporators—the most compact and efficient.

It is not what you pay for an article, but what the article pays you in return for its cost, that determines its real value. . . . . .

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Catalogues and full information are at your disposal.

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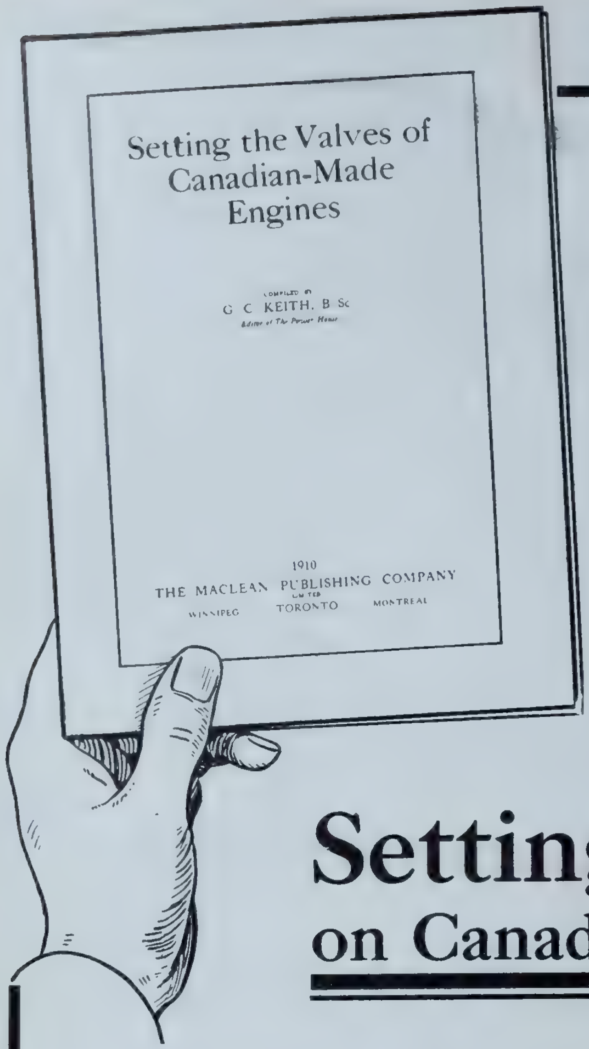

Setting the Valves of
Canadian-Made
Engines

COMPILED BY
G. C. KEITH, B. Sc.
Editor of The Power House

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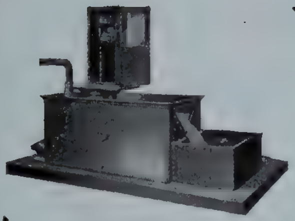

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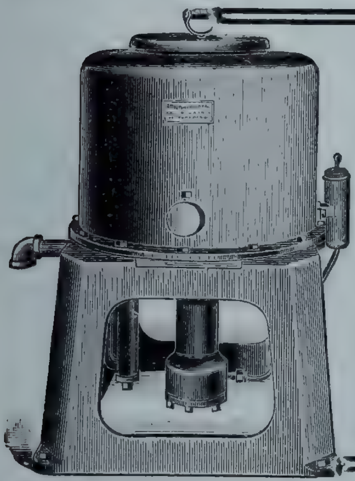

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We Manufacture—OIL and WASTE MACHINES, CHIP MACHINES, TURBINE CENTRIFUGAL OIL FILTERS, and CENTRIFUGAL EMULSION MACHINES

We have machines with---The E. B. Eddy Co., Ltd.; Grand Trunk Railway; Can. Pac. Ry.; Dominion Coal Co.; J. R. Booth; Toronto Water Works; T. Eaton Co.; Montreat Street Ry.; Nova Scotia Steel & Coal Co.; Toronto Railway; Algoma Steel Co.; Quaker Oat Co.; B. Greening Wire Co.; Imperial Oil Co.; Canadian Copper Co.; Sarnia Electric Light Co.: Robert Mitchell Co.; Montreal Rolling Mills; Canada Screw Co.; Crow's Nest Pass Coal Co.; Dominion Iron & Steel Co.; Temiskaming & Northern Ontario Railway Co.; Consolidated Mining & Smelting Co.; Montreal Cotton Co.; Frost & Wood Co., Ltd.; Dominion Textile Co., Ltd., and many others.

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HERE IS THAT LINE

The Canada Metal Co.'s IMPERIAL GENUINE is the one grade of BABBITT METAL that you can be absolutely sure will prove the soundness of your judgment when you specify.

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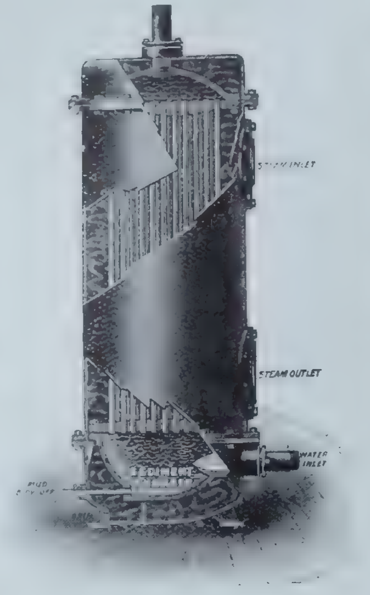
The Canada Metal Co., Ltd., : Toronto

Mackie Patent Heaters

"Made in Canada."



The tube portion of this heater is not attached to the shell. Allowance for free expansion and contraction makes it the most durable heater on the market.

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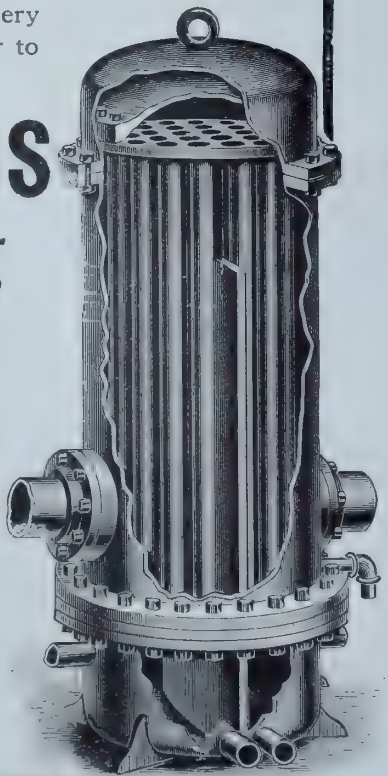
Simple — Effective Well-Constructed

It will amply repay every user of Steam Power to install a

JACOBS

Feed Water HEATER



Each Heater is fully guaranteed, and will positively use your exhaust steam to raise your Feed Water to the boiling point, thus saving considerably on fuel.

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TO THE STATIONARY ENGINEER WHO IS NOT A MEMBER OF THE C. A. S. E.

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We preach the doctrine of elevation of the Engineers through the medium of education.

By joining one of the subordinate associations of the C.A.S.E. you can gain knowledge of the character which is deemed so essential by successful practitioners of all the useful professions.

In all fairness I would ask you if an organization devoted to the calling at which you earn your daily bread is not entitled to special consideration from you?

For further particulars write

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Executive Secretary

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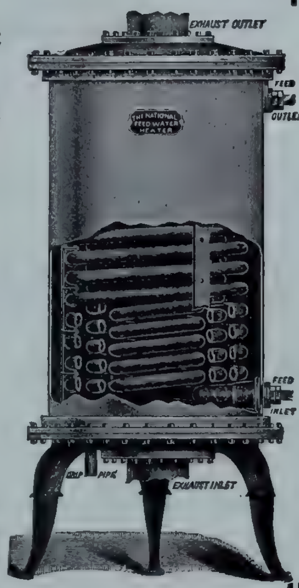
33% of the Heat You Generate

It is an extraordinary fact that in the average steam plant this enormous amount of heat is being wasted.

Stop this unnecessary loss by installing a



NATIONAL Feed Water Heater

A simple, practical and efficient heater that will utilize much of this heat to raise the temperature of your feed water.

It consists of one to 14 coils of seamless drawn brass or copper tubing encased in a cast-iron or steel shell. Exhaust steam is admitted to the shell, heating the water passing through the tubing.

In the "National" there are no inside joints to leak, no leaky straight tubes, no back pressure, and no contact of the water with shell or iron.

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Make Your Exhaust Steam Work For You

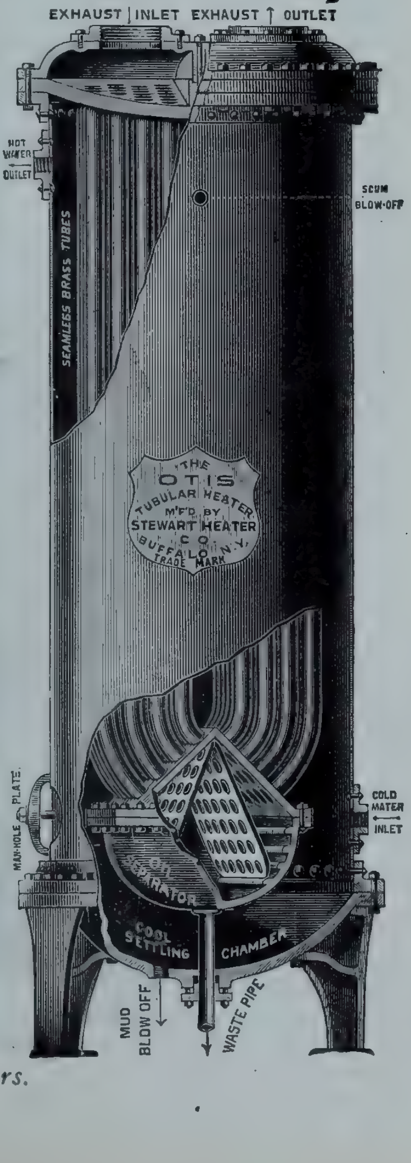
You can halve your fuel bills if you heat your feed-water to the boiling point by passing it through an

OTIS

Tubular Feed Water Heater, Oil Separator and Purifier

There's no back pressure with the "OTIS"—a point greatly in its favor—and it will return the water of condensation from the heating system to the boiler without the additional expense of an eliminator.

The "OTIS" extracts the oil from the exhaust, so that the steam, after passing through the heater, may be used for other heating purposes.



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For Economy and Capacity and For Constant and Uninterrupted Water Circulation : : :

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"HEINE" SAFETY BOILER

is the best on the market for every sized plant, from 100 H. P. up.

Not only is the "Heine" Boiler constructed so as to best absorb and transmit heat, but also so that heat will best reach it.

Durability, Efficiency and ***Safety*** are three features of the "Heine" Boiler due to care and skill in selection of materials, and to the numerous severe tests which are applied to every part of the boiler, and later to the boiler set up complete before shipment.

The "Heine" Drum effectively precipitates and discharges all scale and mud from the boiler.

We invite the fullest enquiry into the merits of the "Heine." Send for our descriptive literature. It will interest you!

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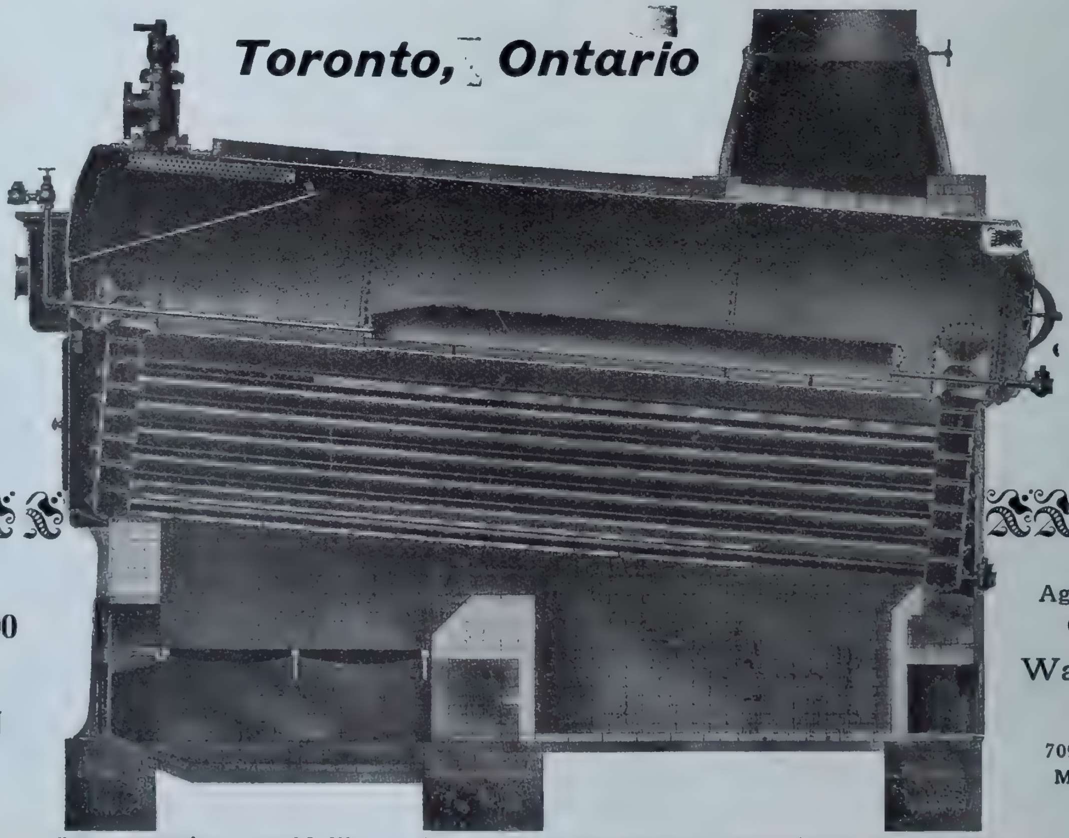

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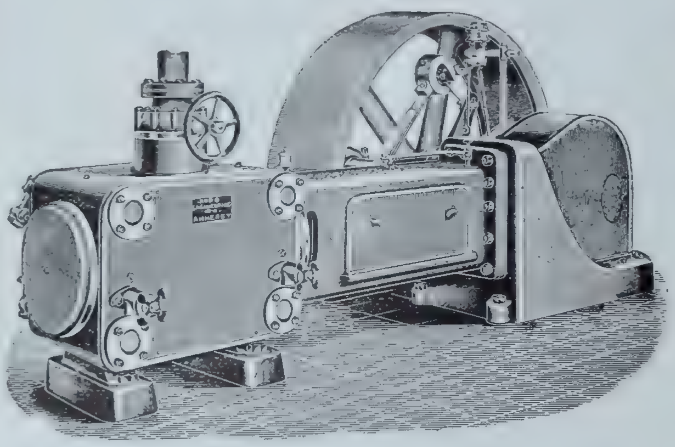

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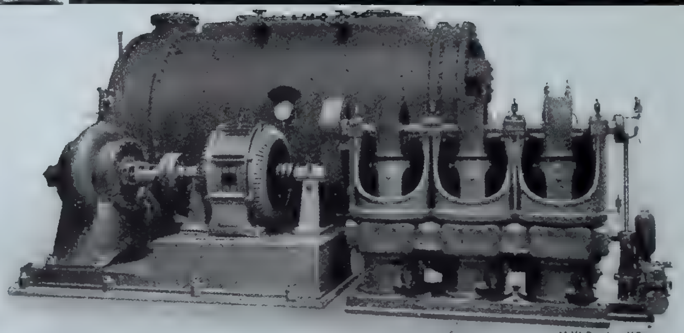

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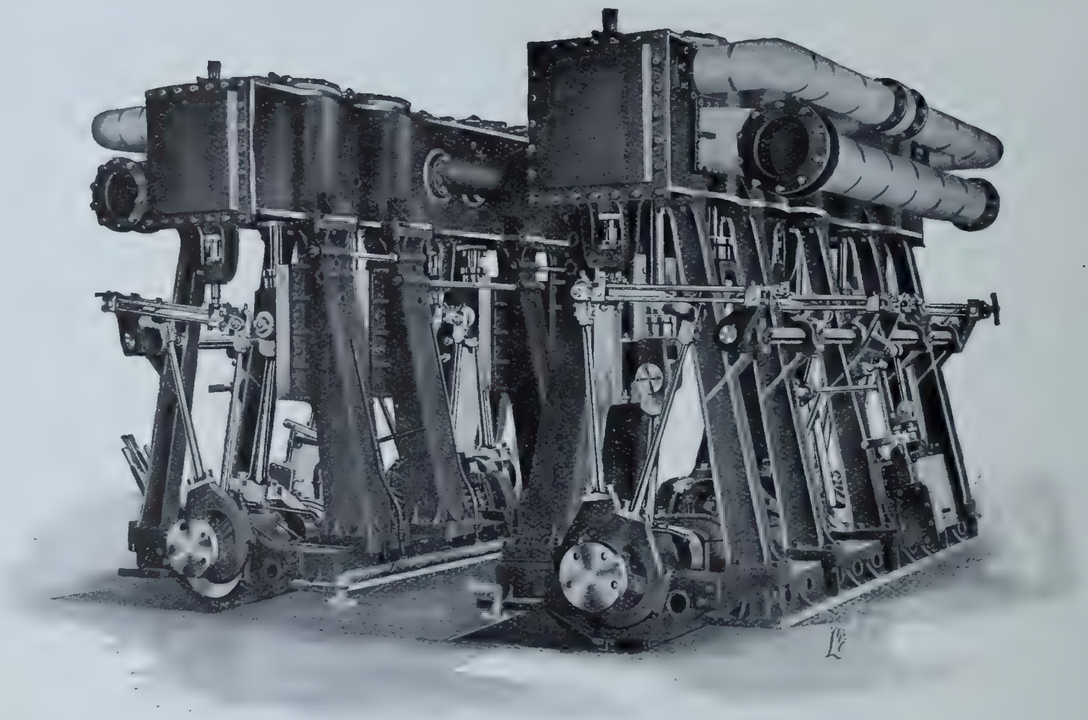

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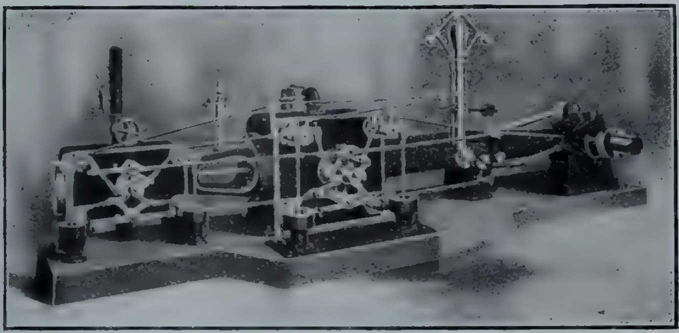

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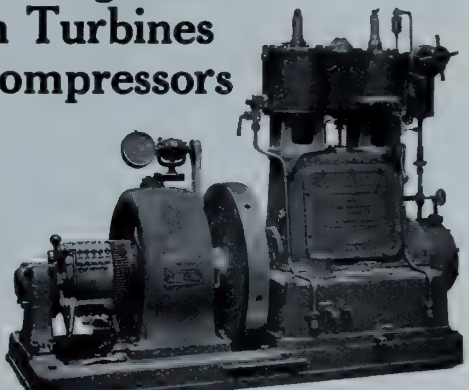

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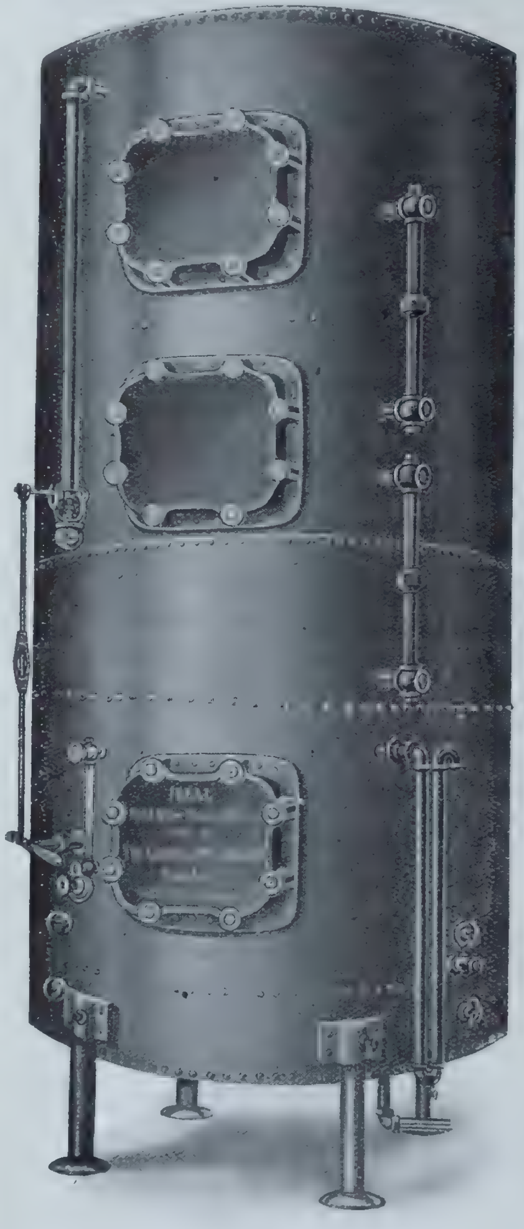

Effectively extracts all oil and grease from exhaust steam.

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Removes all carbonate scale-forming matter from feed water.

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Delivers feed water to boiler at nearly boiling temperature.

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So constructed that all parts are easily accessible.

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This heater is designed to make its installation a good investment rather than merely an expenditure.

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WE MAKE Wheelock Engines, Corliss Engines, Ideal Engines, Boilers, Heaters, Steam and Power Pumps, Condensers, Flour Mill Machinery, Oatmeal Mill Machinery, Transmission and Elevating Machinery, Safes, Vaults and Vault Doors.

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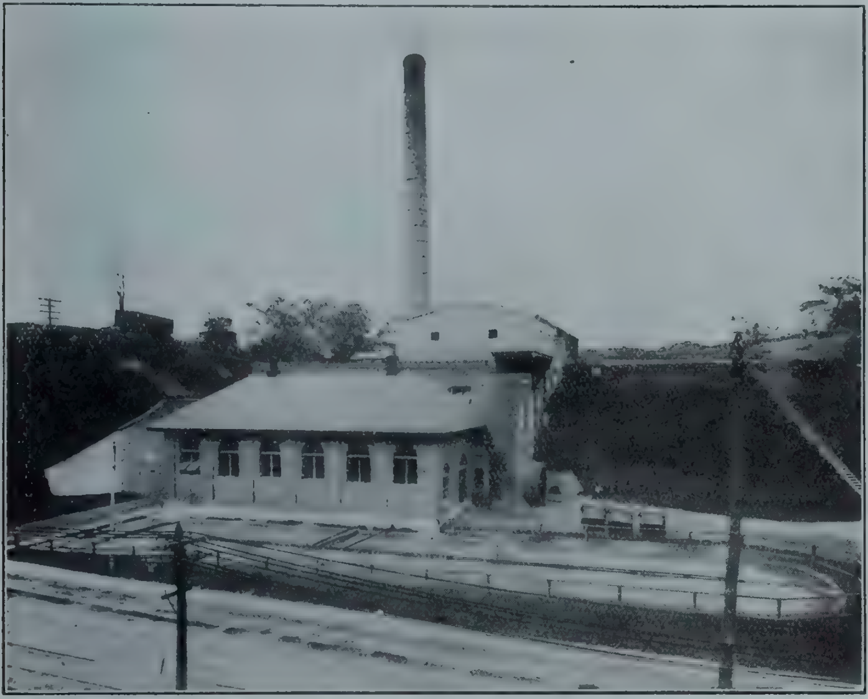
Garbage is Used as Fuel in Municipal Power Plant

In the Campaign for "Cheap Power," Engineers Cannot Afford to Overlook the Use of Garbage in the Production of Power. The Practice of Making Use of Garbage for Municipal Lighting and Power Plants has been in Use in Europe and United States for Some Time. The Growth of Canadian Cities is Presenting a Problem to Municipal Engineers to Dispose of the Garbage. Both Stationary and Municipal Engineers Will be Interested in the Westmount Municipal Power Plant, Where Power is Economically Generated From the City Waste.

THE destruction of "towns' refuse"—the English term for municipal waste—began in London about 1870, by the Messrs. Mead, dust contractors at Paddington, who built the first closed furnaces for disposal of refuse. Because of defects in construction, these were unsuccessful and were discontinued. The idea was taken up by others, and in 1876 the first destructor was built by Alfred Fryer at Manchester. This term "destructor" has come generally into use as describing the several forms of English apparatus used for incineration of refuse. The two original cells which gave life to the whole destructor principle are still in use at Manchester.



General View of Westmount Electric Light and Incinerator Plant, Electric Light Building in Front and Incinerator in Rear.

Mr. Fryer's destructor was of the "cell" type; an oven floored with inclined fire grates, fed through top charging ports, the gases of the combustion passing through side ports to a main flue connected with the chimney. The cells were built in pairs, placed back to back, arranged in rows, all being connected with the main flue. The operation was by natural chimney draft, very high stacks being required to obtain the necessary power. Since the combustion in these early plants was slow and imperfect, it was found necessary to introduce a fume-cremator in the path of the gases, and later a horizontal steam boiler was placed in the main flue to obtain power.

In 1885 the fan was first used for forced draft, an improvement that had far-reaching effect. In 1887, the Horsfall destructor embodied a number of improvements, including the water-tube steam boiler, the exhaust fan and the use of a steam jet blower for the distribution of air through heavy boxes of cast iron, placed at the sides of the fire bars.

The Fryer destructor was improved and changed by the makers, Manlove Alliott & Co., and has kept its position in the foremost line of progress. The Warner "Perfectus" destructor, also of the cell type, has several installations in England.

In 1891, there were some 200 cells at work, destroying 500,000 tons of refuse annually. The Beamen and Deas Cell Destructor appeared in 1893 with other improvements, raising the capacity of the cells to 15 to 20 tons each per day, and developing greater steam power.

The first radical departure from the cell type was made by the Meldrum destructor in 1894. This was the Meldrum continuous grate, with divided ash-pits, and included the regenerative air-heating system for supplying the air for combustion at high temperature by means of steam jets under the fire bars. The introduction of a powerful blast of air heated to 350 deg. F. under each separate grate greatly increased the rate of combustion and preserved the principle of alternate charging of one section or grate, while the adjoining sections were at the highest temperature. The enlargement of the combustion chamber provided for the maintenance of the temperature at a nearly uniform rate, and the complete combustion of the gases before their entrance to the boiler. There was also provision made for the settlement and detention of the fire dust, in the bottom of the combustion chamber and below the generator, in a special dust-collecting chamber. With the aid of these improvements the Meldrum Simplex Destructor obtained a commanding position, installing in the first sixteen years of its work upwards of 110 plants, of which some 90 were in Great Britain and Ireland, the others being distributed in various parts of the world.

Canadian Installations.

The first installation of the British cell destructor on this continent was at Montreal in 1894, when one closely following the original Fryer model went into service, and is still in use. This was followed by a large plant of the same type at San Francisco, but no other installations for municipal service were made.

It was not until 1906 that the first destructor of the modern high-temperature steam-raising form was built by Meldrum Brothers at Westmount. The published reports of the trials for the acceptance of this destructor made in 1906 showed conclusively that the destructor system could be applied under American conditions and obtain very nearly the same results as in the British installations. The trials showed that from 30 to 50 tons of mixed waste, garbage, ashes and refuse could be consumed without additional fuel, developing 200 h.p. of steam at 125 lb. pressure, with an average temperature of 1,900 deg. F. in the combustion chamber, at a cost of 80 cents per ton including all labor for operation, fixed charges and sinking fund. The net cost for labor was 31 cents per ton, and the revenue in steam power delivered to the electric lighting stations was approximately $5,000 per year. The continuous operation of this plant for four years has been so successful that another destructor of the same capacity has been installed.

Following the example of Westmount, another Canadian city, Vancouver, obtained tenders for a destructor plant of 40 tons daily capacity. This contract was awarded to Heenan & Froude, of Manchester, England, the destructor going into service in January, 1907. The reports of May, 1909, showed the disposal of the maximum quantity of waste of low calorific value at a cost of 91 cents per ton, including all operating costs and fixed charges and a net cost of 46 cents per ton after deducting revenue. This city has since contracted for another destructor plant of 140 tons capacity, the steam power from this to be used in several departments of municipal work.

Heenan Destructor.

The Heenan Destructor was evolved from furnaces patented in 1897 and 1901 and assumed nearly its present form in 1902 when built at Barrow, England. As at present constructed, the Heenan Destructor has the continuous grates with closed ash-pits, the air regenerative system with the delivery of the heated air beneath the grates by a fan or blower instead of steam jects. The roof of the furnace is undulating, comprising a series of shallow reverberatory arches over each grate, the purpose being to create eddies or currents of hot air deflected upon the adjoining grates. The air supplied for combustion is heated by the regenerator to about 350 deg. F. and delivered under the ash-pits, at a pressure of 2 to 3 ins. water gage, by a powerful fan driven by steam engine or electric motors. The ventilating systems of air ducts from all parts of the building are connected with the intake of the fan, insuring the removal of dust and preventing its escape to the outside of the works. The clinker removed through the front doors of the furnace is dropped to a lower level below the clinkering floor, where it is held in cooling chambers until nearly all the heat contained in the clinker has been returned to the furnace.

In the latest example there is a supplemental hot-gas duct by which the hot gases from the clinker chambers are passed by means of steam jets through the back wall of the furnace. The purpose of this is to partly dry out the moisture from the refuse as it stands on the back hearth before it is raked over on the fires.

Cable Used for the Removal of Ashes From the Incinerator.

Cooling Tower for Cooling the Water Coming From the Boilers.

Since its construction in nearly its present form in 1902, the Heenan Destructor has undergone many changes, the improvements becoming for obtaining a higher rate of combustion, greater development of steam power, the more economical operation with less exposure of the workmen to the high temperatures in operating the furnaces, and the cooling and more perfect ventilation of all parts of the enclosing building. There have been built, or are now under construction, sixty destructors of the Heenan type since 1902.

Westmount Power Plant.

The Westmount destructor and lighting plant were placed in operation in 1907, the plant recently being doubled in capacity. The plant was designed by Ross & Holgate, Montreal. The first destructor was a three grate, 50 ton continuous pattern supplied by Meldrum Bros., Timperley, England. The second destructor is a Heenan patent refuse three grate destructor. It was manufactured by Heenan & Froude, and supplied through Laurie & Lamb, Montreal, their Canadian agents.

The boiler equipment consists of five B. & W. water-tube boilers of 200 h.p. each. Three are arranged for hand firing with coal and two are connected to destructor. The five boilers are equipped with B. & W. super-heaters. Two of the boilers are equipped with automatic smoke consumers.

The boiler house and destructor occupy a building 80x90 ft. A cable has been constructed for handling clinkers and ashes. This is shown in the illustrations. Two 6 x 4 x 6 in. duplex Knowles pumps supply water to the boilers. Three Knowles condensers, one Webster feed water heater and two Wright traps have been installed.

The cooling tower shown in the illustrations was supplied by the John McDougall Caledonia Iron Works. A simple 7x6 in. Robb engine is direct connected to a pump also supplied by the John McDougall Caledonia Iron Works. A Robb engine of similar type is also direct connected to a fan furnishing air draft for the cooling tower.

Power Generating Plant.

The power house is 70x40 ft. The current distribution is three phase, 60 cycle. The equipment consists of four Crocker-Wheeler generators of 200, 125, 200 and 400 k.w. respectively. The main switchboard consists of twelve sections, the instruments being supplied by the Canadian Westinghouse Co. In addition to this are five panels for the control of the arc lighting, the equipment for these being supplied by the Canadian General Electric Co. In the gallery are the mercury arc rectifiers, the whole equipment for these being supplied by the Canadian General Electric Co.

The generators are direct connected to the engines, three being supplied by the Robb Engineering Co., Amherst, N.S., and one a Bellis & Morcom, supplied by Laurie & Lamb, Montreal. The Robb engines are two of 350 h.p. and one of 200 h.p. The Bellis & Marcom is a 600 h.p. vertical compound.

Test of New Heenan Destructor.

Date—April 12, 1910.

Duration—5.75 hours.

Details of Fuel—

Refuse garbage, etc., mixed, burnt—21110 lbs. equals 86.84 p.c.

Screened combustible ashes—3200 lbs. equals 13.16 p.c.

Unscreened combustible ashes—None.

Total burnt—24310 lbs. equals 100 p.c.

Rate of burning per hour—4106 lbs.

Rate of burning per square foot of grate area per hour—54.6 lbs.

Equivalent rate of burning per 24 hours—99544. lbs. (44.4 tons).

Details of Water and Steam—

Total water evaporated—39985. lbs.

Water evaporated per hour—6954. lbs.

Water evaporated per 1 lb. of fuel burnt—1.69 lbs.

Average boiler pressure (gauge)—130. lbs.

Average temperature of steam (F.)—605 deg.

Average temperature of feed water (F.)—170 deg.

Factor of evaporation—1.22.

Water evaporated per 1 lb. of fuel burnt from and at 212 deg. F.—2.06 lbs.

Average combustion chamber temperature—1972 deg. F.

Maximum combustion chamber temperature—2156 deg. F.

Minimum combustion chamber temperature—1796 deg. F.

Temperature of gases at chimney base—532 deg. F.

Details of Electrical Figures—

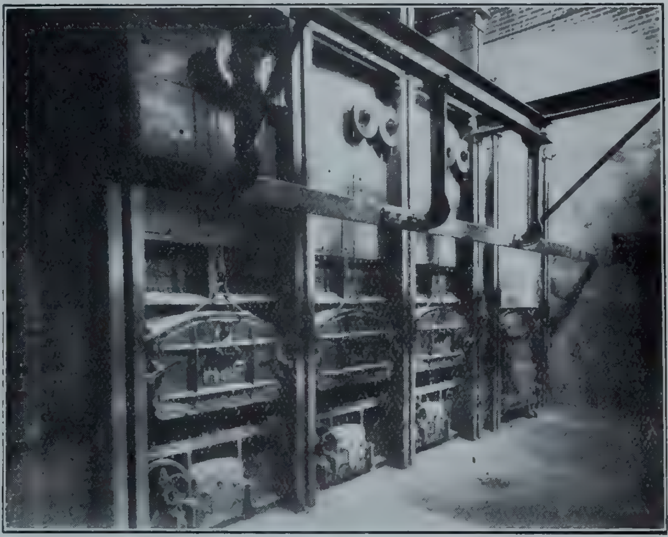
Average kilowatt per hour—135.

Maximum kilowatt—240.

Kw. hours per ton (2,240 lbs.) of fuel burnt—76.5.

Kw. hours per ton (2,240 lbs.) of fuel burnt on basis of 30 lbs. of steam per kw. hour—128.8.

Interior of Shed Showing Bins Where Refuse is Dumped from the Carts to the Furnaces.



One of Two Sets of Furnaces Where Refuse is Burned.

Setting Valve Gear of the John Inglis Corliss Engine

By F. B. Ward *

The Series of Articles on "Setting Valves on Canadian-made Engines" has Been Received with Great Favor by Canadian Engineers. The Accompanying Article, Prepared by the Chief Engineer of the John Inglis Co., is Written in Such a Way as to Show Clearly Setting Valves on the Inglis Corliss, and so that it May be Easily Applied to any Other Corliss Engine as Well.

For about thirty years the John Inglis Co. built the standard type of Corliss engine using the well known Reynolds releasing gear. During the past seven years they have been building an improved Corliss, using a releasing gear having several unique features and improvements which are the result of years of observation and experience.

The Inglis standard line of Corliss engines have single ports, while special and high speed (up to 150 R.P.M.) are built with double ports and with either single or double eccentrics. In all cases the steam valves open outwards, that is, the cutting or working edge is towards the centre of the cylinder and the steam does not travel over the top of the shown in section view of cylinder in steam valve to get into the cylinder, as Fig. 1.

In the Reynolds type of gear the releasing latch or hook latches on the valve arm plate from the outside, as shown in Fig. 2. While in the Inglis gear this hook latches on the inside as shown at O, in Fig. 3, thus utilizing the inertia of the hook to insure latching on, especially at high speeds for which this gear is admirably adapted. This releasing gear will operate without the spring on the hook, but this spring is used to insure holding on of hook when the edges of the steel plates are rounded by wear from long use.

Valve Setting for Single Eccentric Engines.

Removal of the back bonnets, or valve covers, will expose to view the round ends or heads of the valves and chisel marks will be noted which indicate the cutting, or working edges of valves, also corresponding marks on the cylinder will indicate edges of steam and exhaust ports, as shown in Fig. 1.

To Find Length of Rods.

If small, turn the engine over by hand, or if large, loosen eccentric set screws and roll the eccentric until it stands vertical, as shown at A, in Fig. 4, then adjust the eccentric rod B, until the rocker arm stands vertical as shown at C. Then adjust the reach rod D, until wrist plate stands vertical as shown at E, (see marks on top of hub as shown at F.) To accommodate the disconnecting device G, the reach rod D, must make one full turn in making adjustments, this may necessitate leaving the rocker arm slightly out of vertical, but this is not important. The reach rod and eccentric rod should be so adjusted that when the engine is turned over, or the eccentric rolled around on the shaft, the wrist plate will travel to the extreme travel marks on hub as shown at F.

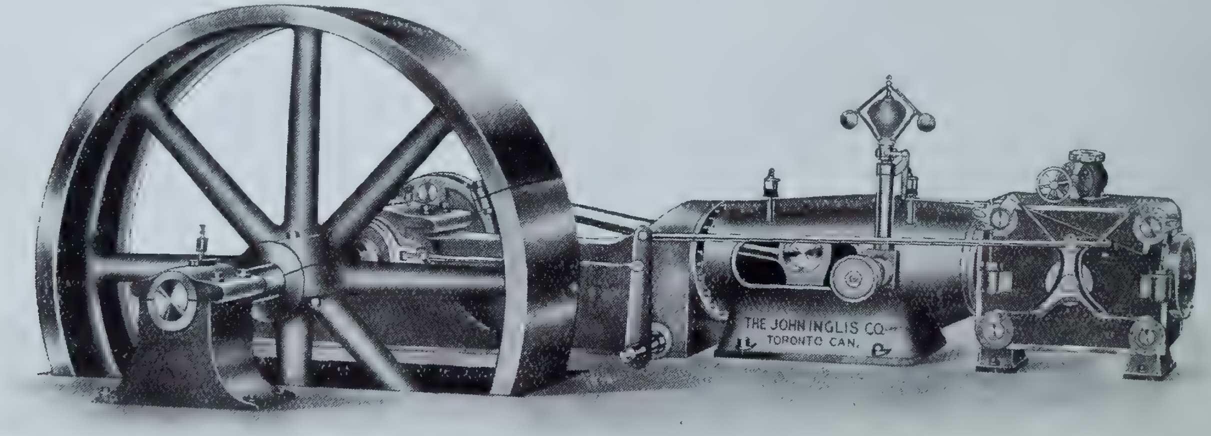
---

* Chief Engineer, John Inglis Co., Toronto.

The reach and eccentric rods are now of the correct length and the jam nuts may be set up tight.

To Set the Valves.

With the wrist plate in central position as shown in Figs. 4 and 5, adjust the steam valve rods H and H, until steam valves have the amount of lap given in the accompanying table, Fig. 6, which is correct for ordinary conditions. Steam lap is shown at K, in Fig. 5. Adjust exhaust rods T and T, until the exhaust valves stand line on line, or have lap at L, as per table Fig. 6.



Corliss Engine of the John Inglis Co., Toronto.

To Set The Eccentric.

As shown in Fig. 7, place the engine crank on centre and move eccentric ahead of the crank in direction the engine is to run, until steam valve shows at M, about the amount of lead given in table Fig. 6. If engine runs at high speed this lead should be increased, no set rule can be given for the exact amount.

To Equalize the Lead.

Fasten the eccentric and then place crank on the other centre and note if the leads are equal. If not the same on both steam valves, adjust rods H and H until leads are equal.

Caution About Length of Vacuum Pot Rods.

In every case when altering length of H, rod N to the vacuum pot must be altered to suit. This should be done when vacuum pot is way down and hook also down, with wrist plate over in its extreme throw. Be sure the pot is way down and then allow about 1-16'' opening between plates O and P. If rod N is too short the hook plate O, will not pick up plate P and valve will not open. If rod N is too long, the hook at Q will come down on top of P, and either break the valve gear, or vac. pot, or bend rods H, or N. It will be found that one full turn of rod H, will require a little over one half of a turn on N, and of course if one is lengthened the other is shortened, or vice versa.

To Set Cut-off Cams.

Throw the wrist plate over to extreme travel (by marks on hub) as shown at R in Fig. 8. Place governor on the stop latch as shown at S, then adjust rod T until cut-off cam U nearly touches but does not trip the tail of hook at V. Now throw the wrist plate over to the other extreme of travel and adjust diagonal rod W, until cam on head end valve just clears the tail of hood as at U and V. This allows the engine to take steam for nearly full stroke when starting up, but as soon as engine is nearly up to speed the governor, as it starts to rise, immediately brings the cut-off cams into contact with and trips the hooks, thus giving cut-off to regulate the speed.

To Set Safety Cams.

Let the governor down as far as it will go, (stop latch out) as shown at S, in Fig. 9. Then set wrist plate at extreme travel as shown at R. Now loosen screw X, and slide safety cam Y on cam ring Z, up under the tail of hook V until hook trips at O. Slide the cam along about $\frac{1}{8}$'' farther and screw cam fast in this position.

Set the safety cam on the other steam valve in the same way. This insures that the steam valves cannot open when the safety stop latch is out and governor down as shown at S, in Fig. 9, as the hook cannot pick up the valve arm. Before the engine can be started the governor must be raised up on the stop latch as shown at S in Fig. 8, hence in stopping the engine the engineer should hold up the safety latch as the governor comes down on same, as shown at S. When setting the safety cams the governor rods T and W, should never be altered.

The above comprises all the operations necessary for setting the Inglis Corliss valve gear without an indicator. It is always advisable to use an indicator where possible as closer adjustments can be made and it is also a check to show whether all the adjustments have been properly made.

It is a well known feature of Corliss engines that if the cut-off is set equal at light loads, it will become unequal at heavier loads and longer cut-offs due to the angularity of connecting rod and often times also due to angularity of improperly designed governor connections. In the valve gear used on the Inglis Corliss this inequality is eliminated by making the head end cut-off lever longer than that on the crank end and making the angle between the centre line of this head end lever and the diagonal governor rod W connecting the two levers, somewhat less than 90 degs. when the governor is in its central position. This is the only Corliss engine using this arrangement and maintaining an equal cut-off at all loads.

Because of this design it is not necessary to go through the procedure of blocking the governor up in mid-position and setting the cams to cut-off at about $\frac{1}{4}$ stroke of crosshead. The Inglis gear is carefully designed and the governor automatically takes its proper position for normal load, and if set according to the direction previously given, will not allow the steam valves to open when the governor is at the extreme top position, due to hooks tripping before valves uncover steam ports, and as before stated, when the governor is at its lowest position the safety cams will not allow hooks to pick up valve arms.

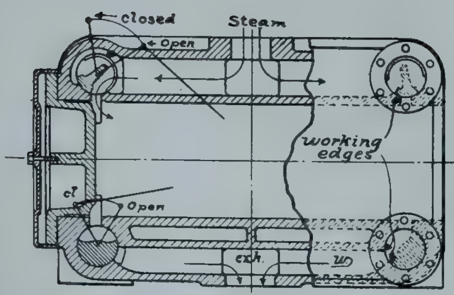


Fig. 1.

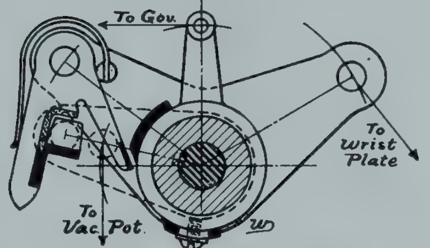


Fig. 2. Reynolds Type Releasing Gear.

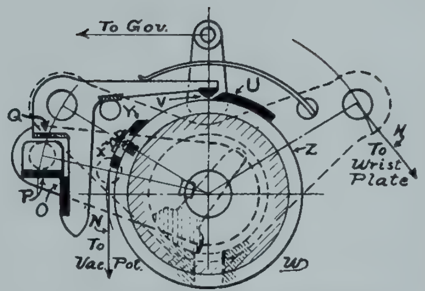


Fig. 3. Inglis Releasing Gear.

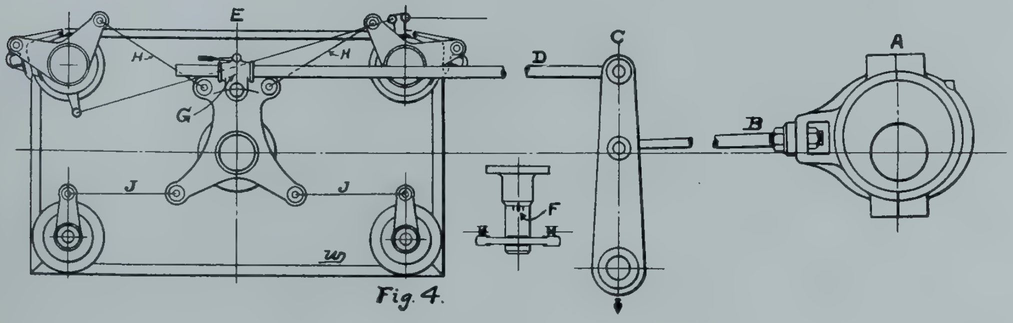


Fig. 4.

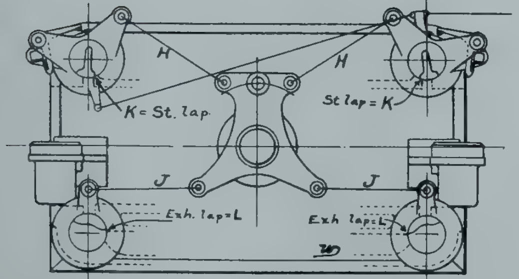


Fig. 5.

Cyl. dia	12"	14"	16"	18"	20"	22"	24"	28"	32"
St. lap	1/16"	3/16"	1/4"	1/4"	1/4"	5/16"	5/16"	3/8"	3/8"
St lead	from 1/16" up to 1/8"								
Exh. lap	from line on line up to 1/8"								

Fig 6. Table of laps & leads.

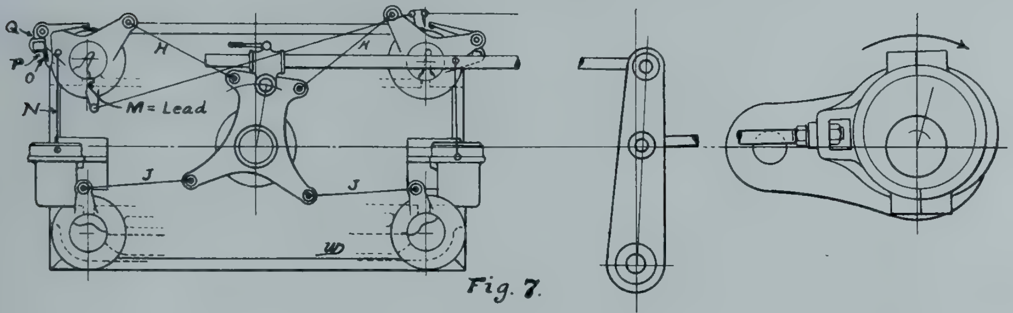


Fig. 7.

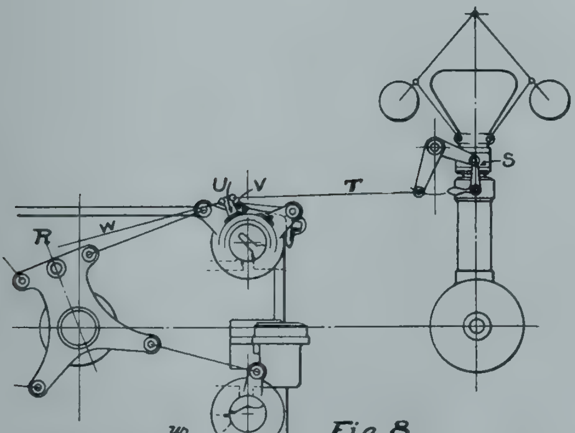


Fig. 8.

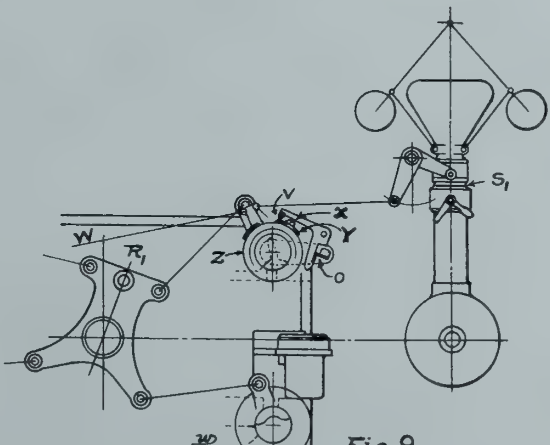


Fig. 9.

Some Questions and Answers for Stationary Engineers

By W. E. T.

During the past Few Months There Have Been Numerous Inquiries for Questions and Answers that Will Assist Engineers in Studying for Their Certificates. If They Will Peruse and Study These Published Herewith Carefully They Will Then be in a Position to Pass Almost any Examination an Examining Board can Prepare.

Q If you were called on to take charge of a plant, what would be your first duty ?

A To ascertain the exact condition of the boiler and its attachments, safety valve, steam gauge, pumps, injector and engine.

Q How often would you clean your boilers if you had ordinary water to use?

A Once a month.

Q What steam pressure will be allowed on a boiler 50 inch D. 318 thick. 60,000 T. S., i.e., of tensile strength factor of safety ?

A One-sixth of texile strength of plate multiplied by the thickness of plate divided by one-half of the diameter of the boiler gives safe working pressure.

Q How much heating surface is allowed per h.p. by boiler builders ?

A Twelve to fifteen ft. for tubular and flue boilers.

Q How do you estimate the strength of a boiler ?

A By its diameter and thickness of metal.

Q Which is the better, single or double riveted ?

A Double is from 16 to 20 per cent. stronger than single.

Q How much grate surface do boiler makers allow for h.p. ?

A About 2-3 square feet.

Q Of what use is a mud-drum to a boiler, if any ?

A For collecting all sediment of the boiler.

Q How often should it be blown out?

A Three or four times a day.

Q Of what use is a steam dome on a boiler ?

A For storage of dry steam.

Q What is the object of a safety valve on a boiler ?

A To relieve pressure.

Q What is your duty in reference to it ?

A To raise it twice a day and see that it is in good order.

Q What is the use of a check valve on a boiler ?

A To prevent the water from return-back into the pump or injector which feeds the boiler.

Q Do you think that a man-hole in the shell on top of a boiler weakens it any ?

A Yes, to a certain extent.

Q Where is the best place to enter the boiler with the feed water ?

A [illegible] water level, but so that the cold water can not strike hot places. If injector is used, this is not so material as feed water is always hot.

Q What are the principal causes of priming in boilers ?

A Too high water, not steam space enough, misconstruction. Engine too large for boiler.

Q How do you keep boilers clean or remove scale therefrom ?

A By regularly opening the boilers and cleaning them thoroughly.

Q If you found a thin plate, what would you do ?

A Put a patch on it.

Q Would you put it on the inside or outside ?

A Inside.

Q Why so ?

A Because the action that has weakened the plate will then set on the patch, and when this is worn it can be replaced.

Q If you found several thin places, what would you do ?

A Patch each and reduce the pressure.

Q If you found a blistered plate ?

A Put a patch on the fire side.

Q If you found a plate at the bottom, buckled ?

A Put a stay through centre of buckle.

Q If you found several plates buckled?

A Stay each and reduce the pressure.

Q What is to be done with a cracked plate ?

A Drill a hole at each end of crack, caulk the crack and put a patch over it ?

Q How do you change the water in the boiler when steam is up ?

A By putting on more feed and opening the surface blow cock.

Q If a safety valve is stuck, how would you relieve the pressure on the boiler, if the steam was up and could not make its escape ?

A Work steam off with engine after covering fires heavy with coal or ash, and when boiler is sufficiently cool, put safety valve in working order.

Q What effect has cold water on hot boiler plates ?

A It will rupture them.

Q Where should the gauge cock be located ?

A The lowest gauge cock ought to be placed about an inch and a half above the top row of flues.

Q How would you have your blow-off located ?

A In the bottom of mud-drum or boiler.

Q How would you have your check-valve arranged ?

A With a stop-cock between check and boiler.

Q How many valves are there in a common plunger pump ?

A Two or more. A receiving and discharge valve.

Q How are they located ?

A One on the suction side, the other on the discharge.

Q How do you find the proper size of safety valve for boilers ?

A Three sq. feet of grate surface is allowed for one inch area of suring-loaded valves ; or two square feet of grate surface to one inch area of common lever valves.

Q Give reason why injectors do not work sometimes ?

A Leak in suction ; leak around plunger ; leaky check-valve ; valve out of order or left too long.

Q How often should boilers be thoroughly examined and tested ?

A Twice a year.

Q How would you test them ?

A With hammer and hydrostatic test, using warm water.

Q Describe the single acting plunger pump ; how it gets and discharges its water ?

A The plunger displaces the air in the water pipe, causes a vacuum which is filled by the atmosphere forcing the water therein ; the receiving valve closes and the plunger forces the water out through the discharge valve.

Q What economy is there in the exhaust injector ?

A From 15 to 25 p.c. saving in fuel.

Q If water is suffered to get low in boiler what may be the result ?

A Burn top of combustion chamber and tubes, perhaps cause an explosion.

Q If water is allowed to get too high what results ?

A Causes priming, perhaps causes breaking of cylinder cover or heads ?

Q What are the principal causes of framing in boiler ?

A Dirty and impure water.

Q How can framing in boilers be stopped ?

A Close throttle and keep closed long enough to show true level of water. If that level is sufficiently high, feeding and blowing off will usually suffice to correct the evil.

Q What would you do if you found your water gone from sight very suddenly ?

A Draw fires and cool off as quickly as possible ; never open or close an outlet of steam when your water is out of sight.

Q What precaution should you take to blow down a boiler of part of the water, if running with good fires ?

A Never leave the blow-off valve, and watch the water level.

Q How much water would you blow off at once while running ?

A Never blow off more than one gauge at a time while running.

Q What general views have you in regard to boiler explosions ? What is the greatest cause ?

A Ignorance and neglect are the greatest causes of boiler explosions.

Q What precaution should the engineer take when necessary to stop with heavy fires ?

A Close dampers, put on injector or pump, and if bleeder is attached, use it.

Q Where is the proper water level in boilers ?

A About 2½ inches over top row of flues.

Q What is an engineer's first duty on entering the boiler room ?

A To ascertain the true water level.

Q When should a boiler be blown out ?

A After it is cooled off ; never while hot.

Q When laying up a boiler what should be done ?

A Clean thoroughly inside and out ; remove all oxidization and paint places with red lead ; examine all stays and braces to see if any are loose or badly worn.

Q What is the last thing to do at night before leaving plant ?

A Look around for greasy waste, hot coals, matches, or anything which could fire the building.

Q What would you do if you had a plant, if in perfect working order ?

A Keep it so, and let well enough alone.

Q Of what use is an indicator ?

A To determine the indicated power developed by an engine, to serve as a guide in setting valves and showing the action of the steam in the cylinder.

Q How would you increase the power of an engine ?

A Increase the speed, or get higher steam pressure ; use less expansion.

Q How do you find the h.p. of an engine ?

A Multiply the speed of the piston in ft. per minute by the M.E.P., and divide by 33,000.

Q Which has the most friction, a perfectly fitted, or an imperfectly fitted valve or bearing ?

A An imperfect one.

Q How hot can you get water under atmospheric pressure with exhaust steam ?

A 212 deg.

Q Does pressure have any influence on the boiling point ?

A Yes.

Q Which do you think the best economy—to run with your throttle wide open, or partyly shut ?

A Always have the throttle wide open on a governor engine.

Q At what temperature has iron the greatest tensile strength ?

A About 6.00 deg.

Q In what position on the shaft does the eccentric stand in relation to the crank ?

A The throw of the eccentric should always be in advance of the crank pin.

Q About how many pounds of water are required to yield one h.p. with our best engines ?

A From 25 to 30 lbs.

Q What is meant by atmospheric pressure ?

A The weight of the atmosphere.

Q What is the weight of the atmosphere at sea level ?

A 14.7 lbs.

Q What is the coal consumption per hour per indicated h.p. ?

A Varies from 1½ to 7 lbs.

Q What is the consumption of coal per hour on a sq. ft. of grate surface ?

A From 10 to 12 lbs.

Q What is the water consumption in lbs. per hour per indicated h.p. ?

A From 25 to 60 lbs.

Q How many lbs. of water can be evaporated with 1 lb. of best soft coal?

A From 7 to 10 lbs.

Q How much steam will one cubic inch of water evaporate under atmospheric pressure ?

A One cubic ft. of steam.

Q What is the weight of a cubic ft. of iron ?

A 486.6 lbs.

Q What is the weight of a sq. ft. of ½-in. boiler plate ?

A 20 lbs.

Q How much wood equals one ton of soft coal for steam purposes ?

A About 4,000 pounds of wood.

Q How long have you run engines ?

Q Have you ever done your own firing ?

Q What is the source of all the power in the steam engine ?

A The heat stored up in the coal.

Q How is the heat liberated from the coal ?

A By combustion.

Q Of what does coal consist ?

A Carbon, hydrogen, nitrogen, sulphur, oxygen and ash.

Q What are the relative proportions of these that enter into coal ?

A The average is 80 p.c. hydrogen, 5 p.c. nitrogen, 1 p.c. sulphur, 2 p.c. oxygen, 7 p.c. ash.

Q What must be mixed with coal before it will burn ?

A Atmospheric air.

Q What is air composed of ?

A 77 p.c. nitrogen to 23 p.c. of oxygen.

Q What parts of the air mixes with the carbon and hydrogen of the coal ?

A The oxygen of the air mixes with the carbon, and the hydrogen with the coal.

Q How much air must mix with the coal ?

A 150 cubic feet of air for every pound of coal.

Q How many pounds of air are required to burn one lb. of carbon ?

A 12 lbs.

Q How many lbs. of air to burn one pound of hydrogen ?

A 36.

Q Is hydrogen hotter than carbon ?

A Yes, 4¼ times hotter.

Q What part of the coal gives out the most heat ?

A The hydrogen does part for part, but as there is so much more of carbon than hydrogen in the coal we get the greatest amount of heat from carbon.

Q How many different ways is heat transmitted ?

A Three, by radiation, by conduction, and convection.

Q If a fire consisted of glowing fuel, show how the heat enters the water and forms steam ?

A The heat from the glowing fuel passes by radiation through the air space above the fuel to the furnace crown ; there it passes through the iron crown by conduction ; there it warms the water resting on the crown, which then rises and parts with its heat to the colder water by conduction till the whole mass of water is heated, then the heated water rises and parts with its steam, so a constant circulation of water is maintained by convection.

Q What does water consist of ?

A Oxygen and hydrogen.

Q In what proportion ?

A 8 of oxygen to 1 of hydrogen.

Q What are the different kinds of heat ?

A Latent heat, sensible heat and total heat.

Q What is meant by latent heat ?

A Heat that does not affect the thermometer and which expends itself in changing the nature of a body, such as turning from a solid to a liquid or from state of gas to a liquid, or from a a liquid to a gaseous state.

Q How can latent heat be recovered ?

A By bringing the body back from a liquid to that of a solid.

Q What is meant by a thermal unit ?

A The heat necessary to raise one pound of water at 390 fr. 1 deg. fahrenheit.

Q If power is in coal, why should we use steam ?

A Because steam has some properties which make it an invaluable agent for applying the energy of heat to the engine ?

Q What is steam ?

A It is an invisible gas generated from water by the application of heat.

Q What are its properties, which make it so valuable to us ?

A 1st. The ease with which we can condense it. 2nd. Its great expansive power. 3rd. The small space which it occupies when condensed.

Q Why do we condense the steam ?

A To form a vacuum and so destroy the back pressure that would otherwise be on the piston, and thus get more useful work out of the steam.

Q What is vacuum ?

A A space void of all pressure.

Q How do you maintain a vacuum ?

A By the steam used being constantly condensed by the cold water or cold tubes, and the air-pump as constantly clearing the condenser out.

Q Why does condensing the used steam form a vacuum ?

A Because a cubic ft. of steam, at atmospheric pressure shrinks into about a cubic inch of water.

Q What do you understand by the term H.P. ?

A That which will raise 33,000 lbs. 1 foot per minute, or 500 lbs. 1 ft. per second.

Q How do you calculate the H.P. of tubular or flue boilers ?

A For tubular boilers multiply the square of the diameter by the length and divide by 4 ; for flue boilers multiply the diameter by length and divide by 4, or multiply area of grate surface in sq. ft. by $1\frac{1}{2}$.

Q What do you understand by lead on an engine's valve ?

A The distance the port is open when the piston is at the extreme end or its travel.

Q What is the clearance of an engine, as the term is applied at the present time.

A The space between the cylinder head and the piston head and the ports.

Q What are considered the greatest improvements on the stationary engine the last 40 years ?

A The governor, the Corliss valve gear, and triple compound expansion.

Q What is meant by triple expansive engine ?

A An engine that has three cylinders and uses the steam three times expansively.

Q What is a condenser as applied to an engine ?

A The condenser is a part of the low pressure engine, and is a receptacle into which the exhaust steam enters and is there condensed.

Q What are the principles which distinguish a high pressure from a low pressure engine ?

A Where no condenser is used and the exhaust steam is open to the atmosphere.

Q About how much gain is there in using the condenser ?

A 17 to 25 per cent. where cost of water is not figured.

Q What do you understand by the use of steam expansively ?

A Where steam admitted at a certain pressure is cut off and allowed to expand to a lower pressure.

Q How many inches of vacuum give the best results ?

A Usually considered 25''.

Q What is meant by a horizontal tandem engine ?

A One cylinder being behind the other with two pistons on same rod ?

Q From what cause do belts have power to drive shafting ?

A By friction or cohesion.

Q What do you understand by lap ?

A Outside lap is that portion of valve which extends beyond the ports when valve is placed on centre of travel, and inside lap is that portion of valve which projects over the ports on the inside or towards the middle of valve.

Q What is the use of lap ?

A To give the engine compression.

Q Where is the dead centre of an engine ?

A The point where the crank and the piston rod lie in the same straight line.

Q What is the strength of American boiler iron ?

A 40,000 to 60,000 pounds per sq. in.

Q What is very high tensile strength in boiler iron apt to go with ?

A Lack of homogeneousness and toughness.

Q What is the advantage of toughness in boiler plate ?

A It stands irregular strains and sudden shocks better.

Q What are the principal defects found in boiler iron ?

A Imperfect welding, brittleness, low ductility.

Q What are the advantgges of steel as a material for boiler plates ?

A Homogenity, tensile strength, malleability, ductility and freedom from lamenations and blisters.

Q What are the disadvantages of steel as a material for boiler plates ?

A It requires greater skill in working than iron, and has as bad qualities, brittleness, low ductility and flaws induced by the pressure of gas bubbles in the ingot.

Q When would you oil an engine ?

A Before starting, and as often while running as necessary.

Q How do you find the proper size of stay bolts for a well made boiler ?

A 1st. the given steam pressure per sq. in. by the square of the distance between centre of stay bolts and divide the product by 6,000 and call the answer "the quotient." 2nd. divide the "quotient" by .7854 and extract the square root of the last quotient ; the answer will give the required diameter of stay bolt at bottom of thread.

Q In what position would place an engine to take up any slack motion in reciprocating parts ?

A Place the engine in position where the least wear takes place on the journals ; that is, in taking up the wear on crank-pin brasses, place the engine on either dead centres, when running, there is but little wear upon the crank-pin at these points, if taking up the cross-head brasses—without disconnecting and swinging the rod—place the engine at half-stroke, which is the extreme point of swing of the rod, hence the least wear.

Q What benefits are derived by using flywheels on steam engine ?

A The energy developed in the cylinder while the steam is doing its work is stored up in the flywheel, and given out by it, while there is no work being done in the cylinder ; that is, when the engine is passing dead centres ; this tends to keep the speed of the engine shaft steady.

Q Name several kinds of reducing motions, as used in Indicator practice ?

A The pantagraph, the pendulum, the drumbo pulley, the reducing wheel.

Q How can an engineer tell from an Indicator diagram, whether the piston or valves are leaking ?

A Leaky steam-valves will cause the expansion curve to become convex ; that is, it will not follow hyperbolic expansion, and will show increased back pressure, but if the exhaust valves leak also one may offset the other, and the Indicator diagram would show no leak. A leaky piston can be detected by a rapid falling in the pressure on the expansion curve, immediately after point of cut-off, it will also show increased back pressure. A falling in pressure in the upper portion of the compression curve shows a leak in the exhaust valve.

Q What would be the best method of treating a badly scaled boiler, that was to be cleaned by a liberal use of compound ?

A 1st. Open the boiler up and note where the loose scale, if any, has lodged. Wash out thoroughly and put in the required amount of compound. While the boiler is in service, open the blow-off valve for a few seconds two or three times a day to be assured that it does not become stopped with scale. After running the boiler for a week, shut down and when the pressure is down and the

Continued on Page 44.

Mechanical and Chemical Methods of Purifying Water

By Gordon C. Keith

Various Methods are Followed for the Treatment of Water for Dyeing, Bleaching, Tanning, Ice Making, Paper Making, Laundries, etc. These are More or Less Standard Methods. For the Purification of Feed Water There are Numerous Mechanical Devices on the Market. There are Also a Number of Large Companies That Analyze Feed Water, Prescribing for its Treatment. The Engineer Should be Familiar With These Devices and Methods, Especially With the Types and Methods .Which are Adaptable to the Plant Under His Charge. This Article Has That Object in View.

PART I.

IN converting water into steam there is under the most favorable conditions a great waste of heat energy. To minimize this loss many inventions have been placed on the market. Heaters, stokers, pipe coverings, etc., all tend to conserve the energy produced by combustion, and to convert it into a potent factor. Manufacturers recognize these accessories as modern developments in steam engineering and consider them good investments.

Manufacturers and engineers are beginning to recognize the saving that may be made by purifying water and removing from it the incrustation and scale-forming constituents, softening the water, etc.

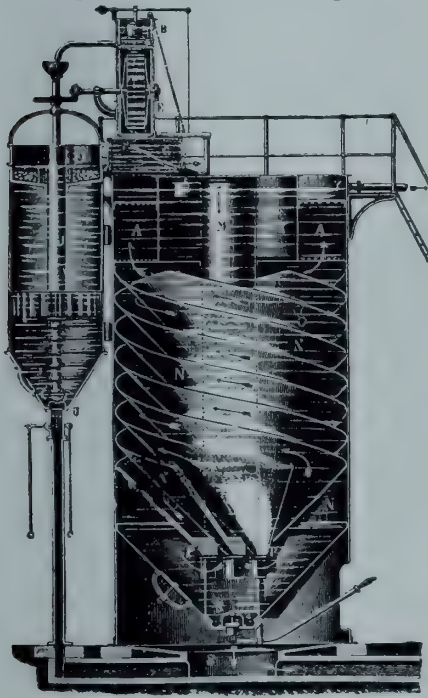


Fig. 1.—Eureka Water Softener and Purifier.

Kent in his hand book states that for each 11 degrees Fahr. of increase in temperature of feed water, a saving of 1 per cent. in fuel is obtained, or 13 per cent. in raising water from 60 to 200 degrees.

On the other hand the table below, taken from "Water Softening and Treatment," by W. H. Booth, M.E., shows conclusively the loss of heating power due to scale in boilers:

Thickness of Scale:

Thickness of Scale.	1-64	1-32	1-16	⅛	3-16	¼	⅜	½	⅝	¾
Loss of Heating Power.	p.c. 2	p.c. 3	p.c. 9	p.c. 18	p.c. 27	p.c. 38	p.c. 48	p.c. 60	p.c. 74	p.c. 90

The object of the above comparison is to show that while about 13 per cent. fuel saving is realized by raising the temperature from 60 to 200 degrees, a layer of boiler scale, of average composition (only 3-32 inch thick) entirely off-sets this saving. Between cleanings the incrustation in boilers frequently attains a thickness of from ⅛ inch to 3-16 inch, which means a loss in heating power of 18 to 27 per cent.

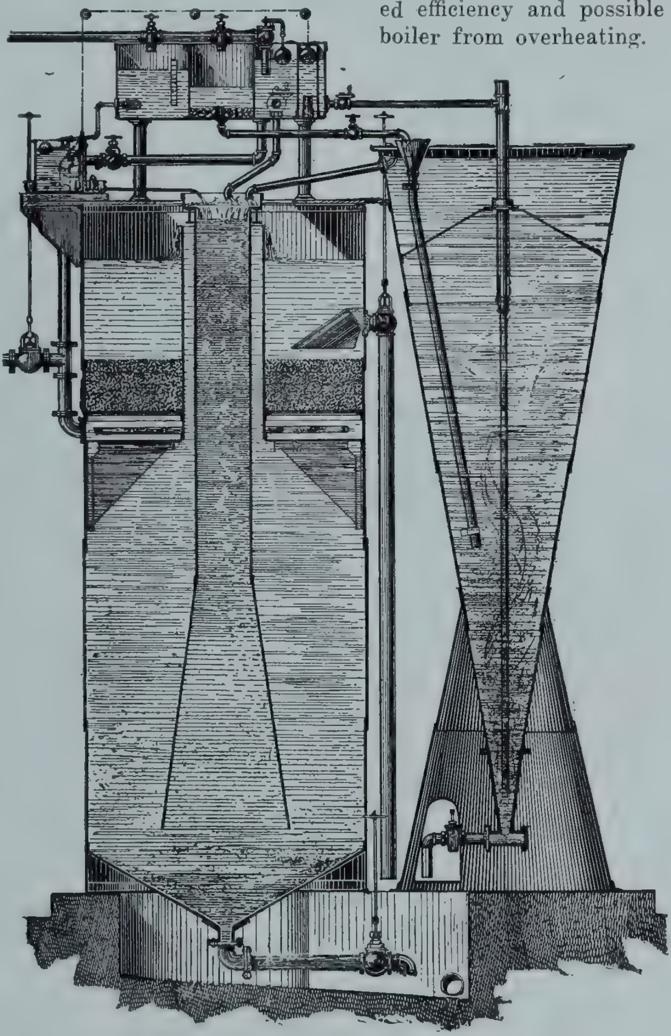


Fig. 2.—Reisert Automatic Water Softener.

Supplee's Mechanical Engineers' Reference Book says:

"Whenever possible, pure water should be used for feeding boilers. When the water is impure the result is the formation of scale, producing diminished efficiency and possible injury to the boiler from overheating.

"The principal impurities in water are calcium carbonate and calcium sulphate, together with suspended earth and organic matter. Water of condensation from steam engines contains more or less oil from the lubricant used in the steam, and this may produce a very injurious coating in the boiler."

The following extract from a paper by Messrs. Hunt and Clapp, in the "Transactions of the American Institute of Mining Engineers for 1888," is an authoritative statement of the subject:

"The large total residue in water used for making steam causes the interior linings of the boilers to become coated, clogs their action, and often produces a dangerous hard scale, which prevents the cooling action of the water from protecting the metal against burning.

"Lime and magnesia bicarbonates in water lose their excess of carbonic acid on boiling, and often, especially when the water contains sulphuric acid, produce, with the other solid residues constantly being formed by the evaporation, a very hard and insoluble scale.

"A larger amount than 100 parts per 100,000 of total solid residue will ordinarily cause troublesome scale, and should condemn the water for use in steam boilers, unless a better supply cannot be obtained.

"The following is a tabulated form of the causes of trouble with water for steam purposes, and the proposed remedies, given by Professor L. M. Norton in his lecture on 'Industrial Chemistry.'

Causes of Incrustation.

1. Deposition of suspended matter.
2. Deposition of dissolved salts from concentration.
3. Deposition of carbonate of lime and magnesia by boiling off carbonic acid, which holds them in solution.
4. Deposition of sulphates of lime, because sulphate of lime is but slightly soluble in cold water, less soluble in hot water, insoluble above 140 degrees C. (284 degrees F.).
5. Deposition of magnesia, because magnesium salts decompose at high temperature.
6. Deposition of lime soap, iron soap, etc., formed by saponification of grease.

Various Means of Preventing Incrustation.

1. Filtration.
2. Blowing off.
3. Use of internal collecting apparatus or devices for directing the circulation.
4. Heating feed water.
5. Chemical or other treatment of water in boiler.
6. Introduction of zinc into boiler.
7. Chemical treatment of water outside of boiler.

Danger Due to Scale.

The danger to life and property of operating sealed boilers is always imminent. The scale prevents the water from coming in contact with the metal and exerting its cooling influence, result: the tube or shell is heated beyond a point where it is capable of withstanding the pressure from within and an explosion follows.

Eureka Water Softener.

The Eureka automatic water softener and purifier, made by the Dodge Manufacturing Co., of Mishawaka, Ind., may be characterized as a saturated lime-water machine, as distinguished from the so-called milk-of-lime apparatus, in which the lime is added without being entirely dissolved before coming in contact with the water which it is desired to purify. The device consists of two portions: a large vertical decanting tank in which the reactions take place, and a smaller, or lime-saturating tank, where some of the water is prepared before passing to the main tank. A sectional elevation, which will aid in explaining its operation, is shown in Fig. 1.

The water may be supplied to the inlet valve in tank B either by pressure or gravity. A constant head is maintained in this tank, and the weight of the water falling on the wheel furnishes all the power required to actuate the plant.

A portion of the raw water is diverted from tank B to saturator J where a clear lime solution of constant strength is manufactured.

The series of spiral plates N accelerate the precipitation of the impurities of the impurities as the water travels upwards after the chemical reaction has occurred. The sludge deposited on these plates gravitates into the cone from whence it is flushed to the sewer by simply opening the valve S for a few seconds daily.

After leaving the spiral accellerators the water passes through a wood fibre A into reservoir Y, from which point it is drawn off for use, all scale-forming matter, mud, etc., having been removed.

The machine starts and stops automatically as water is required and will supply any quantity up to the rated capacity. The attention necessary is about 20 minutes daily, which can be given by the engineer without interference with his regular duties. It is never necessary to enter the machine.

Reisert Water Softener.

The Reisert water softener, shown in Fig. 2, consists of a distributing tank, a reaction and settling tank with mixing pipe and gravel filter.

The distributing tank has three compartments, one for raw water, one for soda ash solution, and one for lime slaking. The water to be treated enters the raw water compartment either by pressure or gravity and the water level in this compartment is always kept constant by means of a float valve. In this compartment the raw water is divided into two portions. The main goes directly to the mixing pipe, the settling tank and the constant water level enables the engineer to regulate this amount. A smaller portion, the exact amount being determined by the quantity of saturated lime water required, is run, by means of a regulating valve, to the bottom of the lime saturator through its centre pipe.

The calculated amount of caustic lime needed for a day's run is slaked in the lime compartment and the milk of lime is drawn to the bottom of the lime saturator. The constant flow of water from the centre pipe carries the lime particles upwards until the velocity of the water becomes so small, on account of the increasing cross-sections of the saturator, that the lime particles cannot follow. Consequently the lime water, which has become completely saturated, always enters the mixing pipe clear and of uniform saturation.

The necessary amount of soda ash needed for a day's run is dissolved in the soda compartment, and from there run by an automatically regulated syphon into the mixing pipe. The flow of soda solution through the syphon is regulated so, that the soda tank is emptied in 12 hours, providing the softener is run at its maximum capacity. If for any reason the softener is not run at full capacity, the syphon automatically delivers a correspondingly smaller amount of soda solution and a graduated scale in the soda tank shows the attendant just how much soda is used. In the same manner, if the softener is not running at full capacity, the amount of lime water delivered to the mixing pipe is automatically regulated to be in direct proportion to the raw-water. In this way the softened water will always be of uniform composition.

In the mixing pipe the raw-water is thoroughly mixed with the lime water and soda solution and is carried down to near the bottom of the settling tank, where most of the precipitated sediment is deposited. After leaving the mixing pipe the water is slowly carried upwards and overflows on the Reisert gravel filter, through which it runs by gravity to the soft water chamber and from there is discharged to the outlet pipe.

The sediment accumulating in the settling tank and lime saturator is drawn off from time to time by means of the sludge valves. The filter bed is washed out daily by reversing the flow of water, stirring up the filter material at the same time by compressed air from an ejector.

The daily work of the engineer is confined to charging the apparatus with chemicals and washing out the filter, occupying about ½ hour daily at the utmost.

Kennicott Water Softener.

The Kennicott method of softening water consists of automatically treating varying quantites of water with proportionately varying quantities of materials in an automatic apparatus which purifies and softens the water at the lowest possible cost.

The Kennicott water softener, as this apparatus is called, is continuous in its action, automatically starting and stopping with the beginning and ceasing of the flow of water into the machine. The water is pumped but once into the softener, and it is delivered at the top. The water as it flows into the softener furnishes all the power the apparatus repuires, both for mixing the chemical re-agents with the water to be purified, as well as for operating automatically all the mechanism of the apparatus.

After the impurities in the water to be treated have been precipitated from the water by the chemical re-agents, they are automatically removed from the water as it passes through the apparatus, and the purified water overflows by gravity from the top of softener into the storage tank.

The machine starts and stops automatically, according to the supply of hard water. The amount of water taken in is regulated entirely, up to the maximum capacity, by the amount of water drawn out.

The diameter of the conical downtake gradually increases, causing the flow of the water to constantly decrease so that the precipitate falls away from the water from which it was formed, and collects in the conical bottom of the main settling tank, whence it is periodically blown out into the sewer by means of a dump valve.

The purified or softened water flows out from the top of the machine; thus the water has sufficient head to run to a separate storage tank without repumping.

MacLeod Water Softener.

The water softener patented by the Pulsometer Engineering Co., Reading, England, is manufactured in Cincinnati, Ohio, by Walter MacLeod & Co. In this system the hard water is admitted to a tank divided by a partition into two unequal portions; the larger of these, which contains a syphon, is called the syphon tank, and the smaller the measurer. The top of the partition is 2 inches below the level at which the syphon begins to discharge. When the level of the water in both compartments has reached the discharge point the syphon automatically discharges the contents of the syphon tank into the mixer, leaving the other compartments brim full. In the syphon tank is a float which, as it descends, lifts, by means of a lever, a valve at the bottom of the measurer, and permits the accurately measured quantity of water to run into the limer, displacing an equal quantity of clear lime water which overflows into the mixer. During its passage upwards in the limer, the water passes through a bed of slaked lime, and on reaching the top has become saturated lime water. The bed of lime is kept stirred up by an agitator worked from the float of the syphon tank.

The soda tank contains a solution of soda of given strength. To the end of the lever worked by the float in the syphon tank is attached a bucket. When the float rises this bucket dips into a sump in the bottom of the soda tank, and when the float descends the bucket is raised brim full. As soon as it is clear of the soda tank it is brought into contact with a syphon, which discharges the contents of the bucket into the mixer.

It will thus be seen that accurately measured quantities of hard water, lime water and soda solution are discharged together into the mixer at every discharge of the syphon.

The discharge of the re-agents is exactly dependent on the quantity of water to be softened. If this is reduced the syphon tank fills fewer times per hour, and consequently the number of times the re-agent measures discharge is reduced in the same proportion.

The discharges from the hard-water syphon tank, and from the lime and soda tanks, all meet at the same time and at the same place, viz., the mixer, and are violently dashed together, thus insuring an immediate and thorough mixture.

From the mixer the treated water passes through a down pipe to the bottom of the settling tank, whence it steadily flows upwards, depositing in its progress the heaviest of the suspended matters caused by the action of the softening process. From here it passes through the filter, emerging at "filter outlet" soft and bright.

The lime tank is recharged with lime daily, and the spent drawn off. The total attention required in the case of medium-sized plants is that of one man for an hour once in twelve hours.

Paterson System.

In the Paterson Cold Process Water Softener, the softening re-agents used are lime for the removal of the temporary hardness, and sodium carbonate for the permanent hardness. These are the cheapest and most satisfactory chemicals known for effecting a softening process.

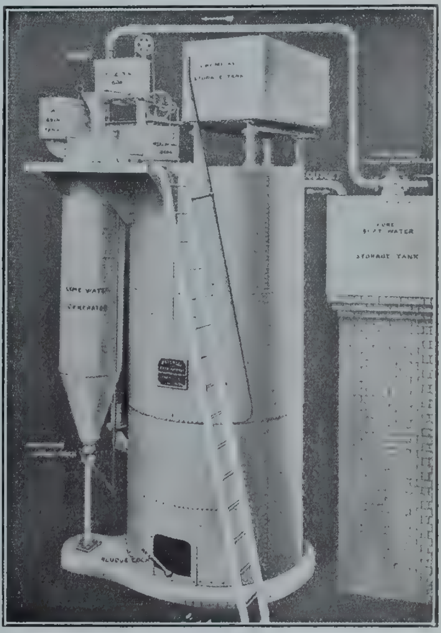
The supply of water to be treated enters the receiving box of the automatic measuring and chemical supply gear, and after passing through a perforated plate, to free it from undue agitation, overflows through a narrow vertical weir into the mixing box below.

This measuring weir, or "tumbling bay," makes the level very sensitive to the amount of water passing, and the level of the water is an accurate measure of the amount. A large float riding on the surface of this water regulates the position of two tapered valves, one controlling the discharge of soda and the other the discharge of water to the lime saturator.

The day's supply of soda is dissolved and poured into the storage tank; a ball valve piped to this tank maintains a uniform head of soda solution above the seat of the tapered valve, to supplement that discharged.

Once a day the supply of lime is prepared in the slaking tank, and run into the saturator in the form of cream of lime. The measuring float controls the position of the tapered valve in the tank overhead, so regulating the amount of water discharged to the saturator. This passes down the central pipe to the conical bottom, and, as it rises, becomes mixed and thoroughly saturated with the cream of lime. The lime particles settle out, and only clear saturated solution of lime water overflows into the mixing box, where it commingles with the hard water and soda.

The softening re-action commences immediately the hard water, lime and soda commingle, very thorough mixing being ensured in a long mixing trough, not fully indicated in the diagrammatic plan. The mixture passes down the external drop pipe shown dotted, entering the precipitating chamber tangen-



Paterson Water Softener, the Canadian Agents Being Laurie & Lamb, Montreal.

tially, to prevent eddies (Fig. 5). The bulk of the impurities settle out here, and are sludged to the drain through the cock provided for the purpose, while the water passes upwards, and strains through wood fibre held in place between two sets of perforated retaining plates. This filtering process practically removes all suspended matter for the first five or six weeks after the plant starts to work, but later the filtrate loses its brilliancy. Where the highest degree of purification must be uniformly maintained, e.g., where the water is to be used for humidifying, or in spinning troughs in textile works, or indeed, in all first-class installations, the final purification is obtained by downward filtration through quartz sand.

The Paterson Engineering Co. make a full line of water purifying apparatus. Among these are systems of softening and purification for steam raising and industrial purposes. Fig. 3 is a typical installation for softening and purifying water for laundries or power plants, when exhaust steam is not available. Laurie & Lamb, Board of Trade Bldg., Montreal are Canadian agents for this system.

Buckeye Floating Skimmer.

In Fig. 4 is shown the Buckeye floating skimmer in return tube boiler with return pipe through top of boiler. The Buckeye floating skimmer illustrated in Fig. 3, is designed to prevent the formation of scale in boilers by the removal of impurities from the water, and may be used in marine, tubular and water tube types.

The device is a wide-mouthed funnel suspended by a tubular arm, through which impurities pass from the surface of the water to the precipitator or settling chamber. The water is returned from this chamber at slightly reduced temperature to the boiler, thus preventing settling of impurities in the boiler and lessening its steaming capacity. The skimmer is always submerged at the same depth, irrespective of the height of the water in the boiler, and whether the rise or fall of the water be rapid or slow, the floats, to be seen attached to the funnel, keep the funnel at the point where the greatest amount of scum will be collected.

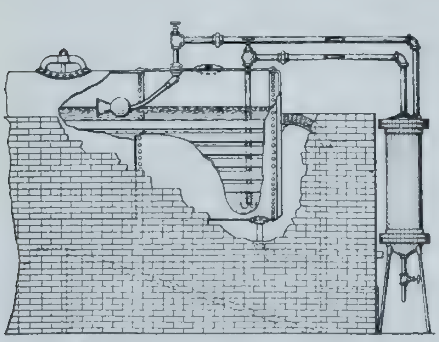


Fig. 4.—Buckeye Floating Skimmer in Return Tubular Boiler.

with loosely fitting disks of strawboard, leather or other material, which are free to whirl, and as the shaft rotates, will

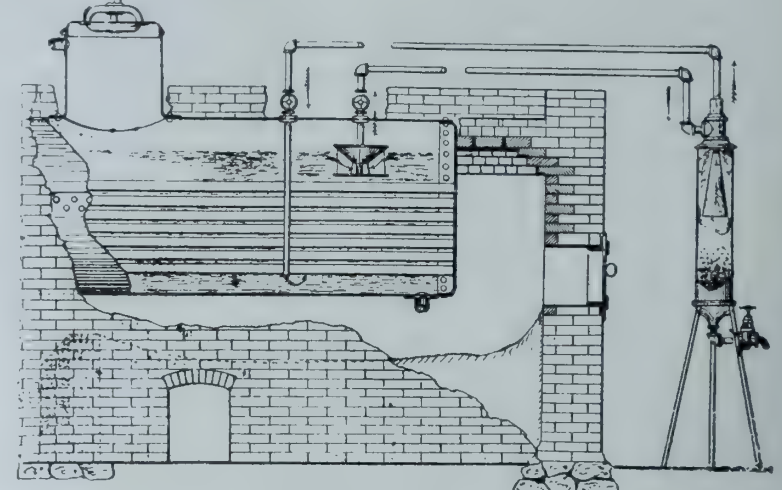


Fig. 5.—Meyers Automatic Boiler Cleaner, for Which C. B. Turner & Co., Box 355, Toronto, are Canadian Agents.

Meyers' Automatic Cleaner.

The two essential parts of the Meyers' cleaner are the skimmer, shown in Fig. 5, which is inside the boiler, and the precipitator, which stands on its own pedestal outside the boiler setting. The skimmer has a conical body with a bottom disc connected to it by four ribs. A tube extends below the conical body and has slotted openings in the end. The ribs are to divide or break up the scum and the sloping side of the cone is to guide foreign matter to the apertures in the tube. The disc at the bottom is to catch that scum and foreign matter which does not enter the tube.

The precipitator or settling tank, which is outside the boiler, is so arranged that when the impurities are delivered into it, they are forced to the cooler outside part and precipitated to the bottom. This sediment is blown off from time to time through a discharge valve at the bottom of the tank. The purified water is carried back, through the inside of the funnel, to the bottom of the boiler. By placing the skimmer in the upper levels of the water in the boiler (where the greater part of the impurities are found) the forced circulation carries the impurities to the settling tank, where the cooler water deposits the impurities and the purified water returns continually to the boiler.

In the January issue additional methods will be illustrated and described.

QUESTIONS AND ANSWERS.

Continued From Page 40.

boiler cooled off, run the water out and take out the hand-hole plates. Note what effect the compound has had on the scale, and where disengaged scale had lodged. Wash out thoroughly and use judgment as to whether it is advisable to use a less or greater quantity of compound, or to add a small quantity daily. Continue the washing out at short intervals, as many boilers have been burned by large quantities of scale dropping on the crown sheets and not being removed.

Q If a condenser was attached to a slide-valve engine that was set to run non-condensing, what changes, if any, would be necessary ?

A More lap would have to be added to the valve to cut off the steam at an earlier point of the stoke ; if not, the initial pressure into the cylinder would be throttled down and the economy to be gained from running condensing lessened.

Q If you carry a vacuum equal to 27½ inches of mercury, what should the temperature of the water in the hot well be ?

A 108 Far.

Q Define specific gravity ?

A The specific gravity of a substance is the number which expresses the relation between the weights of equal volume of that substance and distilled water at 60 deg. Far.

Q Find the specific gravity of a body whose volume is 12 cubic inches, and which floats in water with 7 in. immersed.

A When a body floats in water it displaces a quantity of water equal to the weight of the floating body ; thus, a body of 12 cubic inches in volume floats with 7 inches immersed ; 7 cu. inches of water must be equal in weight to 12 cu. inches of the substance. As specific gravity equals weight of one volume of substance divided by weight of equal volume of water, then specific gravity of the substance in this case equals :

$$\frac{\frac{1}{12}}{7} = \frac{7}{12}$$

Toronto Lodge No. 1 Stationary Engineers Celebrate

The Twenty-second Annual Banquet of the Toronto Lodge, Canadian Association of Stationary Engineers, was Marked by the Attendance of all the Executive Officers of the Association, in Addition to Representatives From the Provincial Parliament and City Council.

THE twenty-second annual banquet of Toronto No. 1, C.A.S.E., was held in the Walker House, Toronto, Dec. 2, 1910. After an enticing supper a number of interesting and instructive speeches were given, the program of songs and toasts being as follows:

The King.

Song—Jas. Hanna.

City of Toronto.—Ald. Daniel Chisholm, chairman of Board of Works, and Ald. Spence.

Song—W. J. Charlebois.

Legislature—Col. Hugh Clark, M.P.P., member for Centre Bruce, and W. G. McPherson, M.P.P., member of West Toronto.

Song—Mr. McDavy.

Manufacturers—Mr. Coates of Dunham Steam Trap Co., Toronto.

Song—Pedlars' Quintette, W. J. Charlebois, H. A. Tucker, R. J. Ormerod, H. G. Fletcher and E. A. Wilkinson.

Educational Interests—W. S. Kirkland, M.A., of Toronto Technical School and A. M. Wickens, chief engineer of Canadian Casualty and Boiler Insurance Co., Toronto.

Song—Walter Blackgrove.

Executive Council.—J. J. Heeg, Guelph, executive president; W. A. Crockett and W. Norris.

Sister Institutions—Joseph Letchford of the Mechanical Institute of Great Britain.

Press—G. C. Keith, editor The Power House, Toronto.

The Speeches.

Col. Clark referred to engineers' certificates. He pointed out that the government had taken a step forward in giving the engineers certificates and he felt sure the stationary engineers would receive every support when progressive legislation was presented to them for consideration.

Mr. McPherson referred to the future of the stationary engineering profession. He thought the name "stationary" engineer was a misnomer, that it should be changed and the association enlarged to take in aviation, automobile and electrical engineers and also engineers in charge of gas and gasoline engines. There would be a mutual educational value in the discussion of questions of interest to all these engineers.

W. S. Kirkland referred to the work at the Toronto Technical School and showed by a few humorous illustrations the value of education along proper lines, to the stationary engineer. It will assist the engineer in securing greater economies in the power plants. He was followed by A. M. Wickens who, for twelve years, was a member of the Toronto Technical School Board. He showed how the engineer was benefited by being educated along engineering lines and showed what the C.A.S.E. were doing in the way of education for its members. The engineers were encouraged to bring their difficulties to the engine room for discussion. Here they are given the assistance of those who understand the problems.

The C. A. S. E.

W. C. McGHIE, TORONTO.

Chairman of Ontario Stationary Engineers' Board Who Was Toast Master at the Toronto No. 1 C.A.S.E. Banquet.

J. J. Heeg spoke on the aims and objects of the C.A.S.E. pointing out that it was an educational body and steps were being taken for greater advancement along this line.

W. A. Crockett showed that the Canadian Manufacturers' Association and the C.A.S.E. were working along the same educational lines. He thought free classes in engineering subjects should be given for the benefit of the engineer to make him a more efficient engineer.

W. Norris pointed out that manufacturers were spending large sums of money to have work done outside of his works that the engineer can, or should be able to do. If the money were spent in providing schools where the engineers could receive free instruction and if they were then given a chance to use their knowledge, it would encourage boys and engineers to attend the schools, and would repay manufacturers with interest.

At the present time in Canada there are few places where a young man can spend his evenings in learning engineering subjects, "and if they do learn," said Mr. Norris, "a goal must be opened for them." Instead of bringing in outsiders these young men should be given a chance to show what they can can do. Technical schools will not do any good unless boys are encouraged to study by giving them a chance when they do study.

Committee in Charge.

The committee in charge of arrangements were W. E. Archer, president; W. C. McGhie, chairman of committee; J. W. Marr, secretary; H. E. Terry, A. M. Wickens, C. Mosely, W. C. Tait, Jno. Brown, A. H. Kirby, J. C. Tweedale, J. Sanderson, G. M. Henderson, and W. Biggar.

NEWS OF SOCIETIES.

Prof. Bain, of Toronto University, will address Toronto Lodge, No. 1 C. A. S. E., on the "Chemistry of Coal," on Jan. 20, in the association rooms, Forum Bldg., Toronto.

The engineering society of the University of New Brunswick held their annual banquet Nov. 15.

The annual banquet of the School of Mining, Kingston, Engineering Society, will be held on Dec. 20.

W. G. Walters, Stratford, has been appointed Hon. Pres. of the C.A.S.E. Exhibitors' Association and D. O. McKinnon, assistant secretary and auditor.

H. M. Burwell read a paper on "A New Water Supply for the City of Vancouver, B.C.," before the Canadian Society of Civil Engineers, 413 Dorchester St., Montreal, on Dec. 5.

C.A S.E. Executive Secretary's Greetings

Brother Engineers,—It must be admitted that the C.A.S.E. has been of real benefit in so far that it was the means of advancing certificate legislation to the present status, and although there has been a certain amount of grumbling at the outset, still the law is being enforced as well as can be expected under the peculiar circumstances of its surroundings. The Board of Examiners have shown their eagerness towards looking into any violation of

The Power House for 1911

Following out our policy of improving and strengthening *The Power House* from time to time, and of making it one of the strongest engineering papers in America, we have just arranged for the publication of a series of articles on boilers, by H. S. Jeffery, who is considered one of the ablest writers in America on this subject.

Every engineer having anything to do with the care of boilers should follow this series of articles closely, and retain the copies for reference purposes, as you may find it necessary to refer back to them at some time when you are having trouble. Tell your engineer friends about this and send in their subscriptions.

Brief Synopsis of Mr. Jeffery's Experience:

Mr. H. S. Jeffery entered the employ at the age of 15 years, as apprentice boilermaker of the Seaboard Air Line Railway, Portsmouth, Va., serving a full apprenticeship.

Worked as journeyman boilermaker for the Wm. Trigg Ship Building Company, Richmond, Va., and for the Newport News Ship Building Company, Newport News, Va., and others.

Entered the employ of the Richmond Locomotive Works, now the American Locomotive Company, at the age of 29 years as Layer Out of boilers, tanks, etc. Following one year's service in this capacity, was promoted to foreman of boiler, tank and sheet iron departments in charge of 600 men.

After about five years' service with the aforesaid company, Mr. Jeffery resigned to accept the position as General Foreman Boilermaker of the Louisville and Nashville Railroad.

The Davenport Locomotive Company, Davenport, Iowa, induced Mr. Jeffery to leave the Louisville and Nashville Railroad Company, to look after the erecting and organization of a new boiler, tank and sheet iron shops; the same being erected and the organization shaped during Mr. Jeffery's administration.

Mr. Jeffery then became associated with the Waterous Engine Works, Brantford, Ont., as Superintendent of their boiler, tank, and sheet iron departments, remaining with them one year, and resigning to accept the position as Principal of the Boilermakers' School, and the Sheet Metal Workers' School, of the International Correspondence Schools of Scranton, Penn'a.

During his three years' service with the aforesaid school, Mr. Jeffery wrote their New Boilermakers' Course (not yet on the market); also, revised their Sheet Metal Pattern Drafting Course. Following the completion of the courses, Mr. Jeffery took up consulting engin-

"The engineer stated that the boiler inspector would not pass his boiler."

eering, relating to boiler, tank, standpipe, structural and sheet iron work.

In this field Mr. Jeffery has urged upon the Federal Government, States, and cities of the United States, the necessity of proper boiler construction and inspection and the licensing of engineers.

Mr. Jeffery has been a large contributor to Motive Power, The Boiler Maker, Power & The Engineer, and the Brotherhood Journal, and starting with January issue of The Power House will write a series of articles on boiler design, construction, operation, repairing, and inspection.

The following is a partial list of subjects which will be treated:

Materials, Factors of Safety, Stresses on Boiler Shells, Riveting, Riveted Joints, Calking, Failures of Riveted Joints, Bracing, Staybolts, Expanding Flues, Leaky Flues, Distribution of Stays, Grate Area, Heating Surface, Tube Area, Boiler Capacity, Safety Valves, Re-enforcing Rings, Manholes, Effects of Punching, Rivets for Bracing, Limitations to Theory, Direct Stays, Indirect Stays, Circulation, etc.

Better Engineers — Not Boilermakers.

We want to impress upon engineers, that they are not being taken into the boilermaking field with the view of making them boilermakers instead of engineers, or both boilermakers and engineers—but, merely better engineers.

This, to a certain extent, can be accomplished by them understanding the underlying principles of construction, designing, inspection, repairing, and operation. Here is an illustration:

Recently, Mr. Jeffery was called out late at night by an engineer, who stated that the boiler inspector would not pass his boiler. It appears that a large part of the shell of a tubular boiler was defective, being removed, and the new plate applied with patch bolts.

It could have been riveted in place with ease, by removing several flues, but this was not done; the foreman boilermaker preferring to use patch bolts, saying that he could do the job quicker, and accordingly cheaper. Looking at the work, Mr. Jeffery took sides with the inspector, and off came the plate, and then the foreman boilermaker told him frankly it was the first repair job of a tubular boiler he had ever supervised. He was formerly a locomotive boilermaker, applying patches to fireboxes, and he did not seem to understand the difference in patching respective boilers.

A feature of the case was that the engineeer questioned in a sort of a way the manner of repairing the boiler, and, while not just satisfied in his own mind, he said, let matters go, thinking, perhaps, that those making the repairs were "onto their job." Instead of a quick and cheap job, they were two days longer out of service than necessary.

If your subscription to "The Power House" is out, renew at once, and secure the benefit of this valuable series of articles, which will start with our January issue, and continue throughout 1911.

THE POWER HOUSE,
143 University Ave.
Toronto.

"Instead of a quick job, they were two days longer out of service than was necessary."

it and the factory inspectors, from my own personal knowledge, are doing their utmost to see that the act is enforced. Under these circumstances, every engineer ought to join hands with an Association that is doing its utmost towards raising the profession to a higher plane.

Although many received their certificates who are not entited to them, still when these leave the positions where they received these certificates, they find it very unprofitable to continue in the profession with a lower status. This can have only one effect, that is, the survival of the fittest. Why then, Mr. Engineer, do you not join us and let us help you make the profession a pride and honor to yourself.

Wishing you a Merry Christmas and a Happy New Year, I am

Fraternally yours,

W. A. CROCKETT.

C.A.S.E. Executive Meeting.

On Dec. 2 the C.A.S.E. executive met at Toronto for a discussion of several questions in connection with the convention at Stratford in July, 1911. Those present were J. J. Heeg, Guelph; Pres.; W. Norris, Chatham, vice-pres.; W. A. Crockett, Mt. Hamilton, Executive Secretary; A. M. Wickens, Toronto, Ex. Treasurer; H. R. Clark, Hamilton, Ex. Doorkeeper, and J. A. Robertson, Stratford, Ex. Conductor.

The executive decided to petition the government with respect to a proposed amendment to the engineers' act, and also that all business in connection with engineers' certificates and boiler construction be in one department to facilitate matters in connection with boiler practice.

A plebesite is to be taken on several questions affecting the good of the order such as bi-annual conventions, graded certificates and interviewing local members of the legislature, etc.

An enlarging of the educational campaign was discussed. Papers will in future be sent to the various lodges to be read before the open lodge for instruction and discussion. If graded certificates are secured, any engineer wanting information to secure certificates will be supplied with material if he will study to improve himself.

Northwest A. S. E.

The fourth annual convention of the Northwest Association of Stationary Engineers will be held in Edmonton during the week between Christmas and New Years. The offices are Grand Chief, Robert Nivens; Vice Grand Chief, F. A. MacLean; Grand Sec'y., E. H. Oliver and Grand Guard, J. E. Kelly.

Ottawa Lodge, C. A. S. E.

At a recent meeting of the Ottawa Lodge C.A.S.E., in St. Joseph Hall. 325 Dalhousie St., Ottawa, Bro. A. Campbell gave a reading from his own experience on the Schwab system of generating steam on two boilers with the fire under the first boiler and the hot gases passing to No. 2, and thence to the smoke stack. This proved a very interesting subject and was listened to very attentively.

Bro. G. I. Scott gave a reading and description of the "Exhaust Steam Heating by the Vacuum System," taken from The Power House.

On Nov. 17 W. C. McGhie, chairman of the Ontario Stationary Engineers, visited Ottawa and with J. Boyce, Boiler Inspector, addressed the Ottawa Lodge C.A.S.E. Mr. McGhie gave an interesting review of what engineers were doing throughout the province and gave a resume of some of his travels and visits to the engineers of other cities and towns. After the meeting a banquet was held at the Bodica Hotel, the repast being followed by a program of songs and toasts.

Toronto Engineers' Club.

The Engineers' Club of Toronto, has been re-organized under a provincial charter, and will hereafter be social as well as business. The new officers are:

Pres., C. M. Canniff; first vice-pres., Willis Chipman; second vice-pres., A. J. VanNostrand; treasurer, L. J. Street; secretary, R. B. Wolsey. Directors, R. A. Baldwin, S. Percy Biggs, W. A. Bucke, C. M. Canniff, Willis Chipman, Dr. John Galbraith, W. Almon Hare, Chas. H. Heys, E. A. James, J. G. Sing, Cecil B. Smith, L. J. Street, Joseph B. Tyrrell, A. J. Van Nostrand, C. R. Young; finance committee, S. P. Biggs, W. A. Bucke, E. A. James; house committee, L. J. Street (chairman), R. A. Baldwin, C. M. Canniff, Willis Chipman, C. H. Heys, J. G. Sing, C. B. Smith; admission committee, Willis Chipman (chairman), Dr. J. Galbraith, C. H. Heys, E. A. James, J. B. Tyrrell, C. R. Young; papers and library committee, A. J. Van Nostrand (chairman), W. A. Hare, C. B. Smith, J. B. Tyrrell, C. B. Young.

Manitoba Stationary Engineers.

The Manitoba association of stationary engineers has secured rooms in the Chamber of Commerce block, Princess St., Winnipeg, and all engineers who wish to become identified with the work of the association or take advantage of such opportunities for reading and study as will be provided are invited to visit the rooms any evening with the exception of Sunday, from 7.30 p.m. to 11 p.m. In addition to a well-supplied table of reading matter, embracing catalogues of the leading manufacturers of engineering supplies, as well as technical and trade journals, it is the intention of the association to establish classes for instruction in the technical side of steam engineering. The need of such instruction has been brought prominently before the association since the Steam Engineering act was passed at the last session of the provincial legislature, and provision made for the examination of stationary engineers. The result of the examinations which have been held clearly demonstrates that a large number of engineers are deficient in that technical knowledge so essential to intelligent work in the engine room, and it will be the aim of the association to supply as far as their means will allow technical instruction to all those who realize the necessity for being better equipped for the discharge of the responsible duties pertaining to the work of the stationary engineer.

Stratford Lodge.

On Nov. 23 the Stratford Lodge No. 30, C.A.S.E., received a visit from J. J. Heeg, Executive President, who addressed them on the aims of the C. A. S. E. John B. Goff, president, and Gordon C. Keith, secretary of the C. A. S. E. Exhibitors' Association, were also present and arrangements were made for the convention and exhibit in Stratford, July 25, 26 and 27, 1910.

Engineers' Union, Toronto.

The Engineers Union holds an open meeting for engineers every fourth Wednesday during the winter months in the Labor Temple, Toronto. On Nov. 23 an open meeting of entertainment and refreshment was held when about 125 engineers were present. The next open meeting will be held on Dec. 28 when a paper on some subject of interest to engineers will be read.

A CORRECTION.

A typographical error in the item which appeared last month with reference to the Blake & Knowles Steam Pumps, stated that Mr. Blake was connected with the building of the fire engine that took the gold medal in London in 1851. This should have read Mr. Wm. Perry of Montreal, not Mr. Blake. Mr. Perry was also the engineer engaged in connection with the other important works further mentioned in the article.

In the advertisement, page 11, the the name of the late Henry B. Worthington should have read Henry R. Worthington, who was the inventor of the Duplex D. A. Steam Pump. To-day the International Steam Pump Co. consists of the Worthington-Blake-Knowles-Deane Steam and Power Pump Co.

ELECTRICITY FOR STATIONARY ENGINEERS

DESIGN OF ELECTRIC POWER PLANTS.*

By H. Baron.

In the supply of electricity to a town or district there is never any telling how large the demand may grow or how rapidly; it therefore behooves the engineer to so design his plant that additions can be quickly and easily made without interfering with the continuous running of the existing plant.

For this reason the primary design should be such that all additions not only tend to retain the symmetry of the whole, but the buildings should be sufficiently large in the first case to take additional engines and boilers without having to be extended themselves for some time to come, and when such is necessary to only require building onto in the same style as the original.

Want of foresight in these matters has caused many municipalities much needless expense, but it has not always been want of foresight, as in some cases when an electricity supply has been started it has outgrown all expectations in so short a time as to surprise the most sanguine and experienced.

As an instance, the writer remembers a city in England which put an addition of 10,000 horse power into their existing power house. So amazed were some of the townspeople that they went to the expense of an official enquiry into what, seemed to them, an absurd and unnecessary outlay. The enquiry showed that the 10,000 h.p. addition was warranted, but what was of greater interest was that within one year of the first unit in the 10,000 h.p. addition being installed, the electricity committee had to advise the town council to advertise for tenders for another 5,000 h.p. of plant as the 10,000 h.p. addition was almost fully loaded up.

Further, when additional engines are installed they are usually larger than those originally installed; as for instance suppose a power house starts with two engines of 500 h.p. each; when an addition is made a unit of 1,000 h.p. would be installed and when a further addition is needed a unit of 1,500 h.p. or 2,000 h.p. would be put down. The buildings therefore should be made large enough in the first case to accommodate these larger sizes of engines, so that there is plenty of room for them and avoiding the unsightly expedient of having some engines standing lengthways and some across the engine room, and even as the writer has seen, engines direct coupled to the dynamos where the cylinders have been flush with the switch board platform and the dynamos underneath it.

There are of course other smaller pieces of machinery besides the engines and generators to install in the engine room, and these require as careful consideration for their location as the larger plant. Boosters, balancers motor-generators, etc., if they are to be placed in the engine room should be in such positions that they can be easily attended to, and so that the mains between them and the switchboard are kept as short as possible and do not interfere with other and more important leads. If at any time they have to be duplicated, spaces should be left for the additions, so that there is no need to take up some other machinery to make room for them.

The same will apply to condensers, circulating pumps, etc. These of course, must be as near to the engines or turbines as possible and a good plan is to have them immediately underneath the engine in what might be called the basement of the engine room. To build an engine room with condensers, air and circulating pumps all on one floor tends to crowd the floor space, whilst to have the engines on one floor and the condensing apparatus in a basement keeps the engine room floor freer from small pieces of machinery and leaves more room to get about. This basement is also extremely useful in many other ways. It enables the foundations of the engines to be easily examined, drain pipes, etc., can be carried underneath the engine room floor, and cables can be easily and safely taken from the generators to the switchboard, whilst there is plenty of room to do repairs, etc. It is not suggested that all this auxiliary machinery in the basement be covered by the engine room floor, but that the floor be left open at these places thereby leaving the machinery exposed to view, a handrailing being placed round the edge to prevent people from falling over.

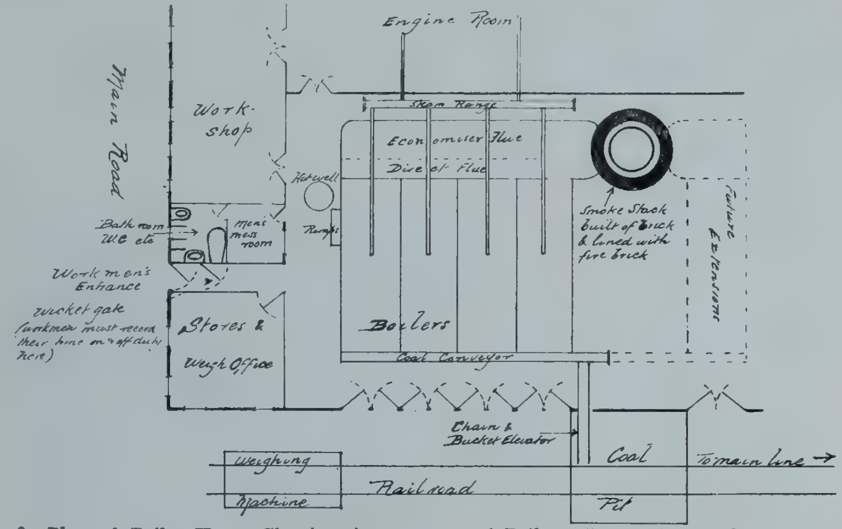


Fig. 3.—Plan of Boiler House Showing Arrangement of Boilers, Smoke Stack, Flues, Coal Conveyor, etc., so that Additional Plant Can Easily be Installed.

Switchboard

Regarding the switchboard, this is the vital core of the central station. On its ease of management greatly depends the easy and safe running of the plant, and also the regular supply of electricity to the outside district.

When a new generator is installed a new panel to control it has to be added to the switchboard, and if a new feeder is put in to supply a new district a panel for that must be added also. To have to pull panels out of this part of a switchboard to make room for others and then put them in some other place, is, to say the least, a clumsy and short sighted way of designing a switchboard.

Many times switchboards are stuck up in some corner where it is impossible to extend them, and then when extensions are needed, a new bit of switchboard has to be placed somewhere else, making the operation of the board both difficult for the operator and possibly dangerous to both men and machinery, besides costing a lot more for extra long cables.

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* Second article of a series. The first appeared in the September issue.

In the writer's opinion the best place for the switchboard is on one of the longest sides of the engine room, well away from everything else, yet within easy distance from the generators. It should be raised a few feet, say 3 feet above the engine room floor, as then the operator can have a clearer view of the whole of the machinery, and see and be seen easily by the engineer, a very necessary thing when paralleling alternators.

The board should also be well away from the wall and well lighted at the back, so that there is plenty of room and light to do repairs or examine connections or apparatus. The back of the board should be kept private from intrusion by unauthorized persons, by a stiff wire netting screen and door. This will keep the back of the board always exposed to view, whilst it cannot be interfered with except by those in charge. The generator panels could, with advantage, be placed in the centre of the board and on each side of it the feeder panels

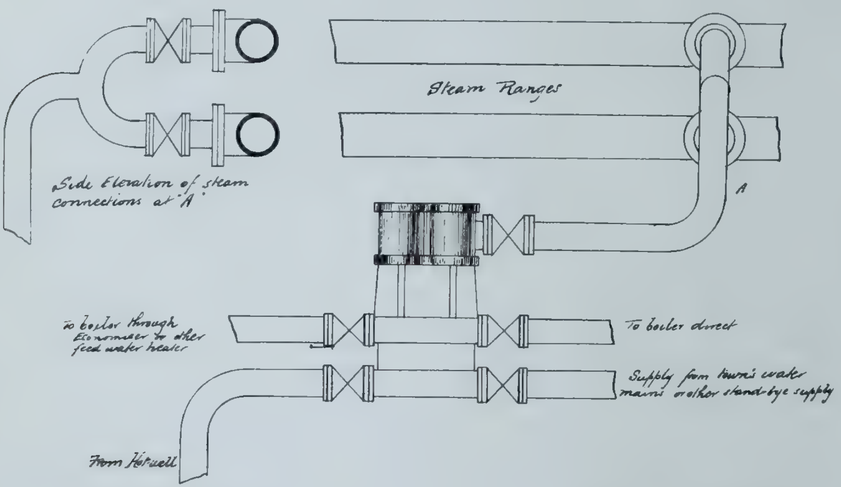

Steam Ranges
Side Elevation of steam connections at "A"
A
to boiler through Economiser or other feed water heater
To boiler direct
Supply from town's water mains or other stand-bye supply
From Hotwell

Fig. 4.—Arrangement of Pump and Connections in Duplicate for Boiler Feed.

If the station supplies power for street cars as well as for lighting and power purposes, the traction feeder panels can be placed on one side of the generator panels, and those for supplying light and power on the other side. By leaving spaces between each set of panels additions can be made to any of them without disturbing the others.

Panels controlling boosters, motor generators, etc., would be best placed near to the generator panels, and those containing instruments for leakage tests, etc., would go at either end of the board.

As much as possible of the switchboard platform should be made of incombustible material, and the operator should be well insulated from all chances of connection to earth. A remarkably good idea for insulating the switchboard operator, that the writer remembers, is where the entire platform was made of thick glass laid in iron frames such as are used for basement lights in street pavements. Rheostats for the control of the exciting current of an alternator, or for the control of the exciter shunt, unless very compact, are best placed under the switchboard platform, the connections being neatly carried down the back of the board from the multiple switch ; or, have a hand.wheel mounted on a pillar directly above, and connected by a spindle to, the multiple switch which is also placed underneath the switchboard platform.

Nothing is more annoying to the operator than to have a lot of small connections behind a large theostat mounted to the back of the board, and not be able to get at them to tighten them up or do anything else with them. Of course these things ought not to be, and some may even think they are impossible, but the writer knows from bitter experience that such are sone. To give but one instance :—

At 4.30 a.m. when on the "all-night" shift, he had to start up a large D.C. generator for the workmen's car service.

To his surprise no voltage was shown on the voltmeter, although the machine was up to speed and there ought to have been at least 600 volts. A careful examination of the machine showed brushes, etc., all right, leads were all right too.

At last he pulled out the plug that made the connection between the generator panel and the voltmeter, and in doing so noticed a kick of the voltmeter needle. He then examined the connections at the back of the board and found one or two loose.

To tighten these connections with the machine running was out of the question, as they were close behind a shunt rheostat with only a few inches between it and the panel, and to have tried to have got a spanner on the nuts would have been to invite a dead short across the generator. There was nothing else to do but to shut down, tighten the connections and start up again.

Boiler House.

Having briefly considered the engine room and its contents, a no less important part claims our attention, viz.,"The Boiler House." Because coal enters largely into the work in the boiler house, some people seem to think that is sufficient reason for having any dingy looking hole for this purpose and having done so, they further confirm their ideas by keeping it so. Now in a ship's hold where immense power has to be crowded into the least space possible, and where owing to various reasons it is necessary to have this great weight as low down as possible, one can reasonably excuse dirt, etc. But on land with nothing to hinder the plenteous allowance of floor space, and with light ad lib., to make the boiler house as black and dark as hades itself, is almost criminal. The pleasure of going through a boiler house with its fires burning bright, the fittings clean, and the whole place neat and tidy, is a delightful contrast to those where one has to climb over heaps of coal and ashes and where the water and steam gauges are so covered with dust as to make it almost impossible to read them.

But even in the design of the boiler house care must be exercised if additions are to be made to it, with ease both to the workmen and in the general running of the plant.

The pumps, feed water pipes, steam pipes, flues and economiser (if used), should be so arranged that they can be added to or extended easily. The economiser is usually built up in sections and inserted in the main flue, then when any fresh boiler is added and the flue extended a corresponding number of economiser sections are added at the same time.

Some boiler houses are built with a separate smoke-stack for each boiler and there is a great deal to be said for this arrangement, as a boiler can be laid off and cleaned throughout, without interfering in anyway with the operation of the plant. Also fresh boilers can be added easily by this method as it doesn't interfere with the draft to the others. The only time when any likelihood of interference with the other plant will be when the feed water and steam pipes come to be connected up. But this multiplicity of smoke-stacks in a large power-house having many boilers would take up considerable room and doubtless lower the efficiency of the plant. The single-smoke stack, therefore, in the writer's opinion, is the best course to adopt for a number of boilers, as the addition of new boilers need not interfere very much with the draft of the others, especially if the work of connecting up the flues is done at night after the heavy load of the day has gone off.

Further, the smoke-stack when erected is a permanent structure and should be large enough to do for a considerably greater number of boilers than may be installed at the time the power house is built. This can easily be allowed for and in Fig. 3 will be seen an arrangement where the smoke-stack would serve an extension of the boiler house to twice its original size, and this without interfering very greatly with the regular working of the plant. The pumps should be placed as near to the boiler fronts as possible, in order that the fireman can have them under his notice whilst attending to his other duties. It is a great nuisance for the fireman to have to go into some other room or round to the back of his boilers to attend to the pumps, especially if through poor coal or a heavy load, he is having a busy time to keep steam up. If the feed water is drawn from a hot well supplied by the condensers in the engine room, there is no reason why the design should not allow of this being placed in the boiler house at some convenient place for the pumps. The pumps themselves should be in duplicate and the feed water pipes in duplicate also, as well as the steam ranges. Fig. 4 illustrates this arrangement.

Besides other reasons which will be dealt with later, this arrangement will permit of the pipe work being extended without any interference with the working of the plant.

A pit for storing coal built outside the boiler house and into which dips a bucket elevator, can be easily filled by carts dumping the coal directly into it after being weighed by the weighman. Or if a spur line is taken from a railroad, the cars can be shunted over or alongside the pit, and the coal unloaded, either by opening doors in the bottom of the car in the former case, or by shovelling by hand in the latter case.

The weighing of the coal can then be done by automatic weighing hoppers placed above the boilers, or (if the weighing machine is of large enough capacity) by weighing the cars when both loaded and empty.

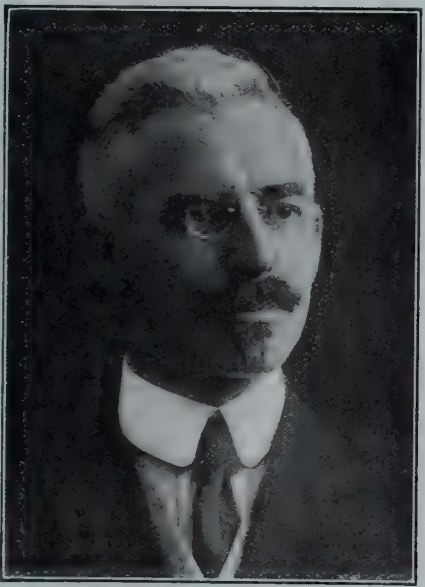
From the pit the elevator lifts the coal into a trough where it travels along by a worm, or by a continuation of buckets carried by chain gear, and which automatically dump themselves into the hoppers of the boilers. As each boiler hopper becomes full, the coal travels on to the next until all are filled.

The advantage of this system of coal conveyance lies in its ease of extension, as, if extra boilers are added, it is an easy matter to attach extra lengths of troughing and worms, or chains and buckets. This machinery can be driven by a small motor placed in some convenient part of the boiler house, where it can be readily attended to, and kept free from dust.

Probably from the foregoing remarks the reader will see that the writer has in mind the use of mechanical stokers along with the coal conveyors, and this the writer believes is the best system to adopt in central electric station work, as by its means many more boilers can be attended to and with far greater ease by fewer men than where the boilers are hand fired. Besides the cleanliness is far greater than where hand firing is adopted, and the firemen working under better conditions will naturally take a greater interest in their work. On the advantages and disadvantages of mechanical and hand firing the writer is not here going to discuss, except to say that his experience has shown mechanical stokers to be far ahead of hand firing in economy of fuel, keeping a steady head of steam under all sorts of conditions, and amount of labor to keep in repair and to work.

ADDITION TO EDITORIAL STAFF.

Since the first issue of The Power House, it has been the aim of the publishers to keep in close touch with the developments in engineering and thus give the readers accurate information on all subjects of interest to them. With the growth of the paper the work of keeping it up to the present high standard has necessitated an addition to its editorial staff. The publishers are pleased to announce that Peter Bain, M.E., formerly of Bain & Mitchell, Montreal, has joined the staff.



PETER BAIN, M.E.,
Associate Editor of The Power House.

Mr. Bain has had 20 years experience in the mechanical engineering field. He is a Clyde technically and practically trained man, having served with Matthew, Paul & Co., manufacturers of stationary, marine and high speed engines. He was on the "Niobe," the cruiser recently bought by the Canadian Government, during her first trials after launching. He was assistant manager at Wm. Spence, Dublin, during the installation of the refrigeration, and mechanical apparatus in connection with the Guinness' brewery extension, and during the construction of a number of locomotives used in this large plant.

Since coming to Canada Mr. Bain served as chief draftsman with the John McDougall Caledonia Iron Works, Montreal, later forming a partnership with Mr. Mitchell, under the title of Bain & Mitchell. He designed the large modern power plant of the Montreal Steel Works, and taught the classes in engineering at the Montreal Y.M.C.A., under the International Y.M.C.A. Educational Board. Many graduates of his classes now occupy important positions in the engineering field. Mr. Bain is therefore well qualified for editorial work on The Power House.

When a gas engine stops suddenly, in nearly every instance a loose or broken connection in the ignition system is the cause. Such stops are also caused, however, by the stoppage of the gasoline supply, as by dirt in the pipe, an air pocket, or water in the carburtor. Lack of lubrication will stop an engine but not suddenly, without warning.

Broken threads on a spark plug, broken gaskets, a cracked exhaust pipe, loose pet cocks and loose igniters cause a hissing sound, while squeaks are usually due to lack of lubrication. Knocking may be due to something loose, but it is often caused by the ignition point being advanced too much or by pre-ignition, due to carbon deposits. If due to looseness of some parts, the flywheel may be loose on the shaft; the main bearings or a connecting-rod box may be worn. Lack of lubrication or too rich a mixture will also produce thumping.

One of the telephone journals tells about a small independent telephone exchange near Columbus, O., which has had some trouble in the operation of its lines at night, owing to the proximity of the high-potential, alternating-current circuits of the electric light company. It is said that, owing to the induction, it is almost impossible to hear over some of the telephone lines because of the noise, but the kindness of the electric company enables the telephone people to do some business in this situation. When a night call comes in for a physician, or any call which is believed by the operator to be urgent, she telephones the lighting company to shut off the supply of electricity in the village while the conversation is being held. With this request the electric light company obligingly complies, and the conversation is uninterupted.

PRACTICAL ARTICLES BY OUR READERS

Readers are Invited to Contribute to this Department with Short Articles or Comments — We Pay for all Available Material.

BOILER FEED WATER IMPURITIES

By R. McLaren.

It is generally considered that if water were pure we would have no boiler troubles, or at least, none that could be chargeable to feed water. But that this is a mistake is evident from the effect of distilled water or condensation on pipes, and the wasting away of gauge glasses is familiar to all of us. Instances are on record of new boilers being installed and fed with pure water in the hope that boiler scale would be avoided. And so it was. But a worse trouble, namely grooving, was encountered.

On ocean going vessels surface condensers are used by means of which the exhaust steam is returned to the boilers. But care is taken that sufficient salt water is fed to the boilers first to produce a thin protection coat of scale. We thus see that water can be too pure. Very few of us, however, are troubled with that kind of water. Our daily struggle being to overcome the effects of impure water.

Impurities differ in their effects. For instance, chloride of magnesium is dangerously corrosive. Carbonate of lime forms a soft muddy scale, which is not very hard to wash off, and which, when it becomes dry can almost be shaken off. But if there is oil or grease in the water, a paste is formed of the carbonate which will stick to the plates and cause overheating.

The sulphates of lime and magnesia form a hard scale that is difficult to get off. The carbonates will precipitate when the water is heated to 212 degrees Fah. The sulphates require a temperature of 290 degrees or over. Earthy matter is held in mechanical suspension in the water and will combine with other scale forming substances to form scale. Very often earthy matter may be removed before entering the boiler by filtration or settling, but sometimes it is too finely divided to be removed in that way. The acids, such as sulphuric, nitric, etc., are corrosive. Acids can be neutralized by means of an alkali. The proper way to treat the water is by means of chemicals and filtration before the water enters the boilers, but as this means a layout of cash for a purifying plant it is seldom used in stationary work. It is used considerably by the railway companies. In stationary work the engineer who usually has nothing to do on Sunday is depended on to remove the scale from the boilers on that day. In a great many cases the engineer, who is usually a dependable fellow, is expected to do a watchman's work on Sunday, and, being on the job anyway he might as well fill in the time between rounds by cleaning the boilers. In this way the expense of a purification plant is saved.

Another method is to purify by heat. This can best be done by means of live steam heater and purifier, of which the Hoppes is a good example. Some heat is lost by radiation, but this loss can be greatly reduced by means of a good covering of mineral wool. The purifier should also get credit for reduced repair bills and increased life of the boiler.

A modification of this method is to use a mechanical cleaner which is a settling chamber located outside the boiler. The water is fed into the boiler and heated and the impurities precipitated. The water circulates through the cleaner, where the impurities are allowed to settle and be blown out periodically, and returns to the boilers clean. We have three of these in operation now and will install six more soon. We can run a boiler six weeks and not get a particle of mud and only a little scale that is bound to drop off until the boiler is clean, where before we would get three-quarters of a barrow load of mud and scale in three weeks.

This method is not a very new one because away back in the seventies or thereabouts the Hotchkiss cleaner was put on the market, and that it did good work is proved by the fact that once in a wihle one is dug out of a scrap pile, broken open out of curiosity, the machine looks a good deal like a bomb) and found to be plugged full of dirt. The machine had been discarded, no doubt because the engineer preferred to spend the time between rounds on Sunday by working inside the boiler, or could it be that he didn't know what it was for and how it should be operated?

We use tri-sodium phosphate along with the cleaner and test the water by means of a 2 per cent. solution of pherrolphthaleine. A drop or two in the water to be tested will cause the water to turn pink if sufficient tri-sodium phosphate is used. The same solution may be used for carbonate of soda (soda ash) or any alkali.

BOILER FEED TROUBLE.

I am using a pair of return tubular boilers, have to each boiler a feed connection direct, and one from heater which is nearly altogether used; water from an 800 ft. well, very strong in sulphur. I use sal-soda to prevent scale. Every little while one of the nipples between the check valve and the boiler goes out, being badly pitted. I suppose I could help matters considerably by putting in a vertical check, but I fear that the water must be very hard on the boilers, and the pitting is of such a nature that an inspection will not show it up until too much damage is done.—Engineer-in-charge.

The writer gathers from the above letter that he is having trouble with the nipples between the check valves and the boiler, in the form of pitting. It is rather strange, if not phenomenal, that the pitting would be confined solely to the nipples.

The writer would not recommend the rearrangement of the piping, and for the reason that the seat of the trouble is elsewhere. Perhaps, the best recommendation would be to recommend the installation of a water purifier. It is evident that if the water is a character to put the nipples, or pipes in connection therewith out of commission due to pitting, the water will affect the boiler likewise more or less.

Of course, if by some strange process, the pitting was confined solely to the nipples, all that would be required would be the use of nipples of a material better able to stand pitting than the commercial nipple. However, I look at this matter from the standpoint that the pitting of the nipples is giving fair warning what will happen to the boilers if steps are not taken to correct the evil.

The writer recommends that a thorough examination of the boiler be made; that the water be analyzed; and if the boiler shows indications of pitting, then install a water purifier—H. S. Jeffery.

I might give you a more explicit description of our trouble with pitting of nipples but it seems that it makes a harder proposition of it.

We have two feed water lines, the main feed water passes through a Webster vacuum feed water heater and purifier and the auxiliary feed is the condensation from the vacuum pump steam heating coils, etc., and is not mixed with any other water and the nipples on that line go the same way. Our boilers are opened up and thoroughly gone over every month as we are on the look out for trouble we use sal soda or common washing soda to catch scale down and the blow off valves are opened and blown through every morning.

Our feed water rarely goes into the boilers at a temperature of 200 Fr. We can and do part of the time, pass the auxiliary feed through the heater and then by main line to boilers.—Engineer-in-charge.

It appears that the difficulty encountered by Engineer-in-Charge is the pitting of the nipples. The inner surface of a nipple, of course, is rough and irregular, yet not broken as is the inner surface of a coupling. Pipe couplings frequently pit and corrode, as the threads within the coupling afford a starting point.

The Engineer says: "Our feed water rarely goes into the boilers at a temperature of 200 Fr." Well, I am a believer in heating the feed water to a temperature corresponding near to that within the boiler.

He also says: "We can and do part of the time pass the auxiliary feed through the heater and then by main line to the boilers." I have seen this attempted before, and while the results did not appear in the way of pitting of the nipples, I really see no reason why all the water, irrespective of the source from which is taken, should not pass through the heater, and be heated as already stated.

The pitting, of course, is the result of attacks from agencies in the water. Even purified water will result in pitting, and because of the air absorbed by the feed water. This is brought about in the following manner.

The cold water coming in contact with a warm pipe or plate, becomes heated and gives up its air, and being in contact with pipe or plate, the air settles upon it. The air containing oxygen and carbonic acid will attack the pipe or plate, and especially irregular surfaces. Subsequent bubbles find a still better lodgement and hence the formation of pit holes. No better place could be found for irregularities than the inner surface of a nipple or pipe.

Dawson, in his Engineering and Electric Traction Pocketbook (page 495) advocates treating the feed water with something which will place a "skin" upon the pipes and plates, and thus keep the water from being in direct contact with the plates.

Distilled water, or the condensation from steam heating systems, is very liable to result in corrosion and pitting. This is due to the accumulation of acids, arising by the decomposition of vegetable oils, used in certain lubricating oils.

My recommendations in this instance are: Purification of the water before same is injected into the boiler; the heating of all water before it is injected into the boiler to a temperature near that within the boiler; and the usual attention to the boiler and heater in regards to scale and mud. I think the trouble in question is due to the causes as given in paragraphs six and eight.—H. S. Jeffery.

LUBRICATION AND PUMPS.

In November issue of The Power House there are two questions asked. One by "Subscriber," and another by "B. C. Reader."

"Subscriber" asks if a force-fed pump for oiling engine cylinders can be made to give equally good results as a sight feed lubricator. The answer is yes. Although I have never handled any myself, I have seen some operated by hand on marine and traction engines; but from an economical point of view, I would prefer a sight feed lubricator working at a drop a minute to these hand devices operated by the engineer when he hears a groan from the direction of the steam chest and cylinder.

But I am informed that there has been placed upon the market recently a mechanical device working automatically, with as good results and with less oil as a sight-feed lubricator.

The oil is fed in more quickly, more regular and in smaller quantities, which is the reason why the lubrication is as efficient as the sight feed.

"B. C. Reader" asks for an explanation as to the term 100 feet piston travel as applied to pumps with examples, etc. I may state that the term "100 feet piston travel" means exactly what it states. That is the piston travels 100 feet.

The usual method is to figure the quantity of water pumped with 100 feet piston travel. A single acting pump empties the cylinder during two strokes only so that if the piston travels 100 feet the cylinder will be emptied one half as many times as the length of the stroke is contained in 100 feet.

In a single cylinder double action pump the cylinder will be emptied as many times as the length of stroke is contained in 100 feet. In a double action duplex pump, twice as many times as the length of stroke is contained in 100 ft.—G. J. Parry.

In answer to Subscriber in November issue re force feed pump for cylinder lubrication, I would say: Some time ago I installed two force feed pumps on the guarantee that they would reduce the amount of cylinder oil used at least 33 1-3 per cent., and that if I was not perfectly satisfied as to their efficiency and economy, I could return them at the end of thirty days. I did not return them. I found that by the use of the force feed pump that I was effecting a saving of 50 per cent. on the main engine, by the use of the pump, and had reduced the consumption of oil perceptibly on the other installations, and had perfect lubrication of the machines.

In answer to B. C. Reader, re piston speed applied to pumps, 1 single action pump, that means that this pump has to make 2 strokes with only one action of suction and one action of discharge valves, and if the length of the stroke was 12 inches, that the pump would make the 100 feet of piston travel while the valves would have only acted 50 times. With the single cylinder double action, the results would be the same, with this difference, that with every displacement of the cylinder there would be the operation of one suction and one discharge valve, and the pump would have double the capacity. With the double action duplex pump, it would be practically the same as the single cylinder double action pump, as you would have two pumps side by side, and each side could attain 100 feet piston speed per minute, and would increase the capacity 4 times. Piston speed means the distance the piston travels, and in this case has nothing to do with strokes.—W. G. Walters.

Replying to Subscriber, on Lubrication of Cylinders, page 62, November issue, force feed lubrication for cylinder is, in my opinion better than the hydrostatic feed. In the first place, changes of temperature do not affect the force feed method, whereas, with the sight feed method, should the lubricator get cold at all, the oil becomes thicker, and consequently feeds slower. Also when the sight feed lubricator is empty, it has to be shut off (which stops lubrication), the water drained off and filled up with oil again. In many cases, the lubricator is not full until it runs over, and where there are many lubricators, the waste oil soon amounts up in 12 months' time. A first class force feed lubricator, when adjusted to deliver the right quantity of oil, can be depended upon to feed a fixed amount per stroke of the pump. It can be filled whilst running, and does not require to be full to work. Lubrication starts and stops with the engine, so there is no chance of forgetting to close the lubricator when shutting down.

The following is an explanation which I trust will be satisfactory to B. C. Reader, in which he wants some information on "Piston travel of pumps." We will assume for simplicity, that the types of pumps mentioned have a 12-inch stroke. In the single action pump (which is usually a vertical plunger pump, eccentric driven), making 100 strokes, or 50 R.P.M., the upstroke is suction and the downstroke the delivery. The effective strokes or deliveries per minute will be 50, though the piston or plunger is travelling 100 feet per minute. In the double action, single cylinder pump, making 100 strokes per minute, each side of the water piston is suction and delivery alternately; that is to say, when one side of the piston is open to the supply, the other side is delivering to the boiler or other apparatus. If the piston travels 100 feet per minute, the deliveries will be 100, or twice as many as the single action. The duplex double acting pump, is simply two double acting single cylinders, and the capacity will be just twice as much as the double action single cylinder pump. It will be seen from this that the piston speed is found by multiplying the length of stroke in feet (or part of feet) by the number of strokes per minute, or length of stroke in inches, and number of strokes per minute, and divide by 12. —J. C. Tweedale.

Subscriber asks about oil pumps in November number. I have used sight feed lubricators and force-fed oil pumps to lubricate engine cylinders, and it is my belief that an oil pump, if properly made to work automatically, is away ahead of the ordinary sight feed lubricator in economy, efficiency, reliability, and cleanliness.

In answer to B. C. Reader in same number would say, the piston speed is the number of feet traveled per minute by the pump plunger when **discharging** water, that is, it equals the length of the stroke in feet multiplied by the number of **working** strokes per minute.

In a single action pump water is discharged only when the piston moves in one direction. With a double-action pump the number of strokes during which discharge occurs is equal to the total number of strokes that the piston makes. With a duplex double-action pump it is customary when giving the number of strokes per minute to refer only to the number of strokes made by one piston, which, obviously, is only one-half the total number of strokes made. However, among engineers this practice varies, some using both strokes to estimate number of strokes.

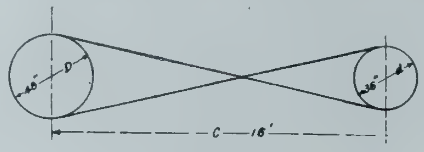
In direct acting pumps it is customary to design them on the assumption of having 100 feet piston speed or travel, and then to run faster or slower to suit required delivery. The foregoing may be of use to B. C. Reader.—J. E. Noble.

LENGTH OF BELTS.

In the October issue of "The Power House" is an item by S. H. W. on the length of belt required before pulleys are in position. The formula as it appears in print is misleading (owing to an oversight by the printer) in multiplying the two diameters (D d) instead of adding thus (D+d).

I would here like to add another formula for the same purpose, also the approximate length of crossed belts under the same circumstances, (that is, before pulleys are in position.

D=diameter of large pulley.
d=diameter of small pulley.
C=distance between shaft centres.
L=length of belt.
all dimensions to be taken in inches.



Length of Belt.

For open belts.

$$L=[1.57(D+d)\ +2C]$$

For crossed belts.

$$L=[1.57(D+d)+2C]\ +\left[14.28\left(\frac{D+d}{C}\right)\right]$$

Example:

diameter of large pulley=48 inches.
diameter of small pulley=36 inches.
distance between shafts = 16 feet.

For a crossed belt.

$$L=[1.57(48+36)\ +2\times 192]\ +\left[14.28\left(\frac{48+36}{192}\right)\right]$$

$$=515.88+6.25=522.13 \text{ inches.}$$

$$522.13\div 12 = 43 \text{ ft. } 6 \text{ inches nearly.}$$

—J. H. R.

BELTS AND DRESSING.

We noticed a little article in a recent issue of The Power House on the subject of belts and proper dressings. In this article the writer refers to the use of castor oil and recommends it as the best dressing he has ever tried. The particular feature that the writer emphasizes is the ability of castor oil to impregnate the fibres of the belt proper, thus softening it and increasing its clinging powers.

A good belt dressing must necessarily penetrate the belt in order to properly "feed" it. A dressing that merely stays on the surface is an immediate remedy only and does not assist the belt in permanently carrying its load. There is one objection, however, to castor oil that has been pointed out by experts who have made a study of the question, and that is the fact that castor oil and practically all animal oils, contains active acid principles which tend eventually to take the "life" out of the leather, causing it to become flabby and lose strength.

Dixon's Traction Belt Dressing is just as efficient as castor oil as far as penetration of the leather is concerned. Unlike castor oil, it does not contain any acid principles which cause the belt to deteriorate. We use it ourselves on belting throughout our own factory and recently made a record of eighteen years constant running of the belts in one of our shops, without even finding it necessary to tighten them throughout this period. This we believe is a pretty good record for a belt dressing and gives a true basis for our confidence in it.—Joseph Dixon Crucible Co.

A QUESTION OF FUEL.

A reader of The Power House interested in the heating of a large office building, wishes the views of those with experience, on the suitability of "Run of Mine" coal for a low pressure return tubular boiler (15 pounds), hand fired, without automatic damper regulation and with natural draft only.

SOME MAY NOT KNOW.

Why the return tubular boiler with which we are all so familiar has its diameter limited to about 7 feet as a maximum, and why the ring seams in all boilers are as a rule only single riveted. Let us have your ideas briefly.

AIR COMPRESSION.

I would like to know the reason of giving an air compressor any more compression in the steam cylinder than that required to reduce the loss from clearance. From my point of view I think the air piston is quite sufficient to perform those duties, the air pressure being at its maximum on the piston at that part of the stroke. I consider that it is an unnecessary resistance.—Cyril S. Walters.

ONTARIO CERTIFICATES.

What are the requirements necessary for an Ontario Engineers' Certificate? Where are the examinations held?—Toronto Subscriber.

You may write your examinations at the Parliament Buildings, Toronto. By writing W. C. McGhie, Parliament Buildings, Toronto, you promptly receive full information in regard to examinations.—Editor.

VULCAN SOOT CLEANER.

In the description of the Vulcan Soot Cleaner made by the Vulcan Tube Cleaning Co., 204 St. James St., Montreal, it read that the cleaner operates while the smoke box doors are "cold." This should have read "closed."

Mr. Nichols, of Vandeleur & Nichols, Toronto, is in England at present visiting the works of the firm's agencies.

George W. Williams, until recently on the engineering staff of Brill & Gardner, Chicago, Ill., has been made manager of the Chapman Engine & Mfg. Co., Dundas, Ont.

NEW EQUIPMENT *for* POWER PLANTS

To Have a Place in this Department the Machine or Appliance Must
Have New and Interesting Features — No Write-Ups Can be Used.

GOETZE GASKETS AND VALVE DISKS.

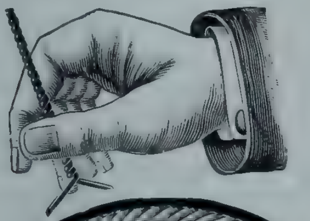
The Goetze copper and metal gaskets here illustrated provide a packing material which will comply with all requirements. They are so arranged as to present a surface that conforms to every irregularity in the flanges, while effectively resisting high pressure and temperature.

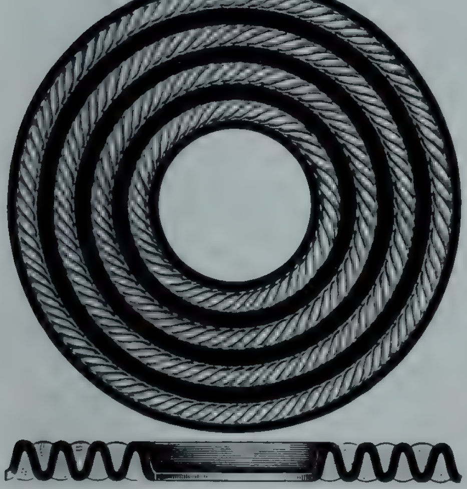
The Goetze Elastic Corrugated Copper Gaskets with Asbestos Lining No. 2, are made of chemically pure copper and best asbestos. A few turns on the flange bolts brings each copper corrugation snugly against the flange surface and at the same time crowds each wall of asbestos against the same surface.

The Goetze Copper Valve Disks with Asbestos Inlaid, having all the elasticity needed for tight closing, and with great durability under most unfavorable conditions, in sizes suitable for McAvity-Victor and Jenkins valves, also other valves of similar construction, are kept in stock.

Goetzerit Sheet Packings.

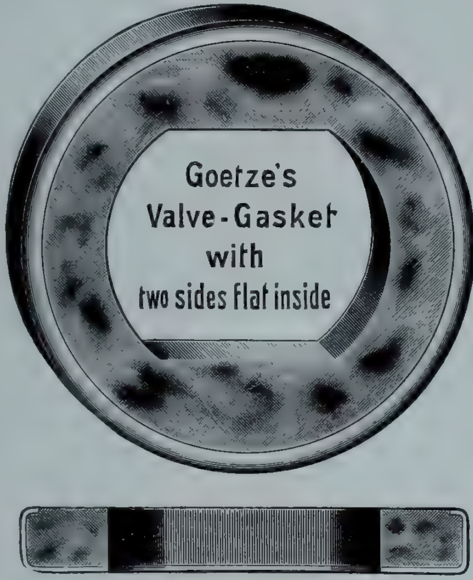
In spite of the advantages of "Goetze" copper and metal gaskets, there are those who wish to cut their own packings from the sheet, or who for some reason do not want a metal or shaped gasket. For such, "Goetzerit," a sheet packing has been perfected.





Goetze Copper Gasket.

It is made in both red and white, from asbestos fiber, compressed under an exceedingly high pressure, impregnated with a substance which, it is claimed, makes it absolutely proof against the action of superheated and saturated steam. "Goetzerit" white packing, is especially recommended for oils, benzine, petroleum, acids, ammonia, gas, alkaline products, etc.



Goetze Valve Gasket.

"Goetzerit" red packing, is made in any desired thickness in sheets 36 inches square. The white is made in sheets 45 inches square.

Ready-made "Goetzerit" gaskets for standard and extra heavy flanged fittings of from 1 to 24 inches are also made. Another kind of packing known as self-lubricating high-pressure packing, equally suitable for saturated and superheated steam, hot and cold water, is prepared for all kinds of stuffing boxes and manufactured in sizes from ¼ to 2 inches square.

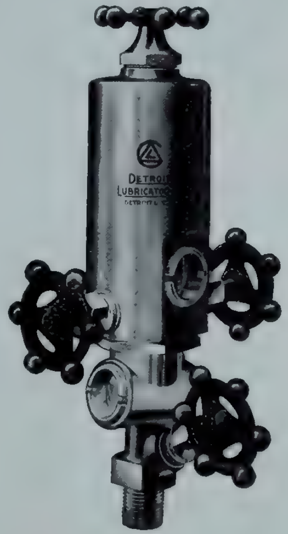
These packings are manufactured by the American Goetze-Gasket & Packing Co., New Brunswick, N.J., and in Canada carried in stock by T. McAvity & Sons, Ltd., St. John, N.B.

AIR COMPRESSOR LUBRICATOR.

The Detroit Lubricator Co., Detroit, recently placed on the market an air compressor lubricator with several improvements over previous devices. The Detroit "500" as it is called can be started and stopped without changing the feed and pressure adjustments. It has three valves; an oil valve controls the admision of oil to the valve which in turn regulates the rate of feed, and a valve in the support arm prevents excessive back pressure which would cause the oil to spatter the sight feed glass.

The oil supply valve allows a permanent adjustment of the feed and pressure valves because it alone controls the admission of oil to the feed and the other valves do not have to be turned off to stop the feed and turned on to start it. After the adjustment is once made, it stays right because it never has to be changed. In starting, all the operator has to do is give the oil valve three or four turns and the oil runs through the other valves just as it did the day before, because the adjustment is exactly the same and was not changed.

The Detroit "500" is strong and substantial throughout—designed for rigorous service and carefully made. The gauge glass in the body is of the bullseye type and capable of withstanding any pressure to which it may be subjected. This lubricator is furnished in two types—the "500" regular with heavy tubular glass for pressure not exceeding 300 lbs., and the "500" extra heavy with bullseye glass for pressure of 300 lbs. or more.

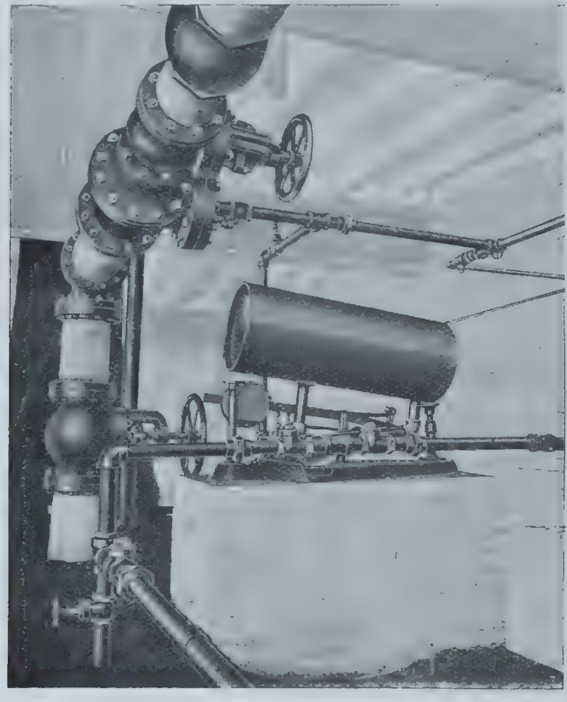


Detroit "500" Air Compressor Lubricator.

MOREHEAD CONDENSER TRAP.

A new method of draining exhaust steam and reduced pressure heating systems of both water and air, and with the same agent create a vacuum to insure positive and rapid circulation, has been devised, patented and put in a successful operation by the Morehead Mfg. Co., of Detroit, Michigan.

The new device is known as the Morehead condenser trap and is in general



Morehead Return Trap on Top of the Boiler at the Plant of the E.M.F. Motor Car Co., Port Huron, Michigan. This is the Upper Trap Employed in Connection with the Condenser Trap System. The Trap is Shown in Tilting Position, Discharging Into the Boiler.

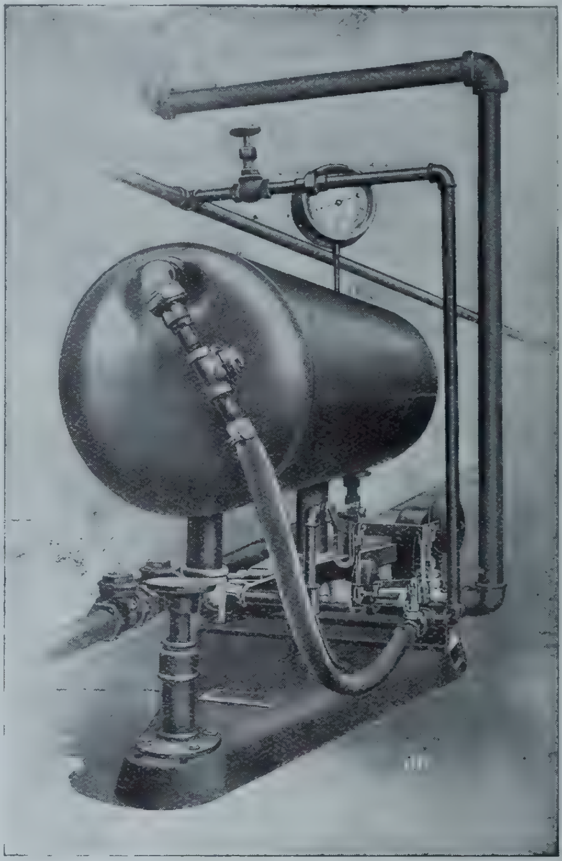
appearance similar to the old and well known Morehead return steam trap. In detail the condenser trap differs from the return trap in the addition of a cold water connection made through a flexible tube with the tank of the trap. The flexible connection terminates in a perforated pipe inside of, and running the length of the trap tank. In short, the condenser trap is nothing more or less than a combination of the principles of the jet condenser and the Morehead automatic return steam trap.

Connected to the return line of vacum heating systems where a difference of pressure is maintained between the ends af the system, the line condensation and accumulating air is taken into the tank of the condenser trap as in the case of the return trap, but with the added pulling power of the vacuum created in the tank of the condenser trap.

When the steam is turned on in the heating system, the various lines of which are full of air, the cold water supply valve as shown in the sectional view of the trap is opened slightly. As the condensation from the return lines and the condensing water fills the tank, the latter tilts, opening the live steam valve allowing the steam pressure to enter and discharge the water contents into a return steam trap above the boiler or into an open heater.

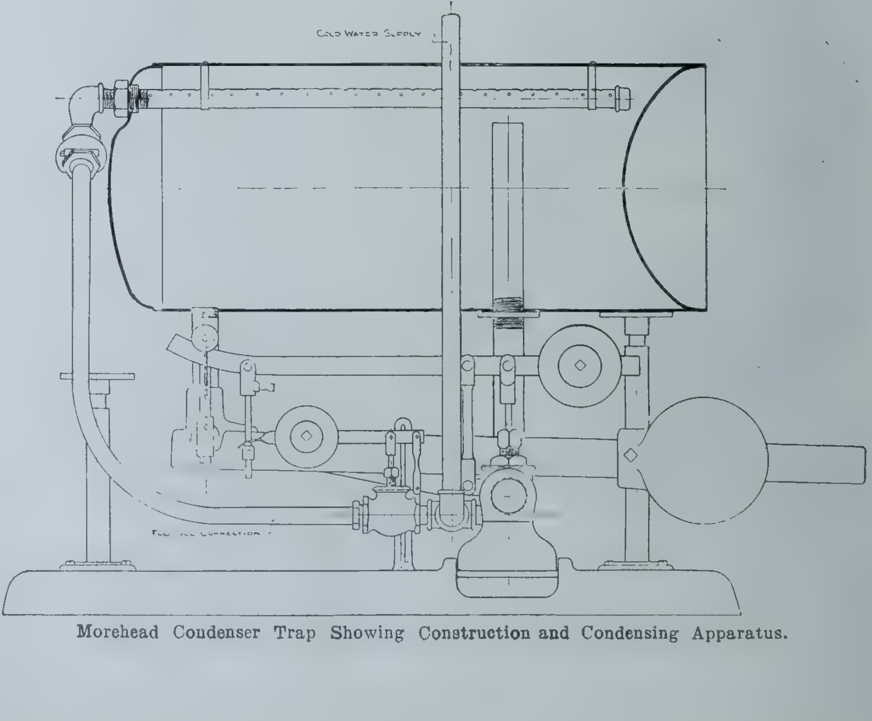
As soon as the water is discharged, the tank, containing the steam which is left after the water is discharged, resumes a horizontal or filling position. The tank returning to its horizontal position automatically opens the control valve on the cold water in-let and allows the cold water spray to come in contact with the live steam contained in the tank. This cold water condenses the steam and forms a vacuum in the tank of the trap which in turn performs the usual functions of created vacuum in heating systems, of pulling the condensation from the lines to be drained.

The cold water supply is furnished either from city water works or a tank or any other source that is available for that purpose. Particular attention is called to the fact that a surprisingly small amount of water is required in the condensing process.



Morehead Condenser Trap at the Plant of the E.M.F. Motor Car Co., Port Huron, Michigan

A receiver is always used in connection with the condenser trap, the water seal in the receiver taking the place of



Morehead Coudenser Trap Showing Construction and Condensing Apparatus.

thermostatic valves on the heating system. The condenser trap is used as the lower trap, taking the place of the return trap in the Morehead standard double trap installation, the lower or condenser trap discharging to the return trap placed above the boiler.

As the study of a typical installation is the more interesting and convincing method of describing the workings and advantages of the new condenser trap, the installation at the E. M. F. Motor Car Co. of Port Huron, Michigan, is referred to and illustrated herewith.

The plant of the E. M. F. Motor Car Co. is a two-storey brick structure, equipped with a large extent of glass area for profuse day lighting. Electric power from an outside source being used exclusively for operating factory, a special 125 h.p. boiler was installed for heating purposes. On top of the boiler is located a No. 4 Morehead steam trap and boiler feed receiving the condensation from the No. 4 Morehead condenser trap situated along side of the boiler on the floor of the boiler room. Under the floor at a depth of about 5 feet is the receiver connecting the return lines and the condenser trap.

The piping in the entire system is equivalent to 60,000 feet of 1-inch pipe. The main supply pipe is brought up to make an overhead feed, using wall coils throughout the factory and cast iron radiation in the office. The boiler room and office are located at extreme ends of the plant.

The returns from all the radiators run along the first floor. When a door is reached, the pipe is carried under the door and brought back to the floor, thus forming a pocket and providing no fall whatever in any of the return lines.

The returns before reaching the boiler house are gathered into one 3-inch main return pipe which carries the condensation to the receiver located in the pit below the condenser trap. From the receiver the condensation is drawn into the condenser trap; thence lifted to the return trap on top of the boiler which in turn discharges it into the boiler. The distance in height between the two traps is about 15 feet.

A pressure of from 25 to 40 lbs. pressure is carried on the boiler and reduced to 1½ pounds on the system. With this initial pressure of 1½ pounds the condenser trap is pulling a vacuum of 25 inches.

During a test run in zero weather this plant was operated for 23 successive hours on three tons of Saginaw slack coal, a highly economical performance according to the management of the plant. They further state that there was not a minute's trouble or even the expense of a cent connected with the workings of the traps during the entire winter period. To one acquainted with the care and operation of steam traps, it is of interest to know that during the foregoing mentioned period not a piece of packing was put into either machine, the return trap or the condenser trap.

In addition to the foregoing mentioned typical installation, the condenser trap has been successfully applied to reduced pressure and exhaust heating in connection with fan ventilating and heating systems and dry kilns. In every case there has been shown a reduced consumption of steam, an increased efficiency in the systems and an especially marked reduction in the coal bills.

At this writing the Morehead condenser trap system is being installed in a number of the large textile mills located in the New England district.

The condenser trap was tried out successfully during all of last winter in the Fort Wayne High School at Fort Wayne, Indiana. The Maumee Brick & Tile Co. of the same city installed the system last spring. The economic results following the installation of the condenser trap at the above institutions led to the adoption of the system by a number of the large manufacturing plants in the same territory.

CENTRAL HEATING PLANT.

The work on the central heating plant, Toronto University, is making satisfactory progress, and expectations are that the whole will be completed by May 1911. The 6 x 5 foot tunnel extending from the buildings on College to Bloor Street, is now practically completed north to Hoskin, and hopes are entertained that the high pressure steam main will be in operation between the medical building and the library in about three weeks' time.

This tunnel will carry the high and low pressure steam mains, return mains, wires and cables for lighting, power, telephone, watchman's clock, etc.

The roof is now on the power house, principal contents of which are Babcock and Wilcox boilers, aggregating 1,600 H.P., two Robb-Armstrong vertical enclosed self-lubricating quick revolution engines, one Waterous horz. tendem engine, and one 300 K.W. Curk's turbine. The combined capacity of the engines and turbine is 600 K.W., with a working steam pressure from the boilers of 160 pounds per sq. inch. The present scheme embraces all the University buildings with the exception of the forestry building, women's residence, and university school. Provision is made for the heating, etc., of additional buildings as occasions arises. The consulting engineers are Griggs and Holbrook, New York, and the architects, Darling and Pearson, Toronto.

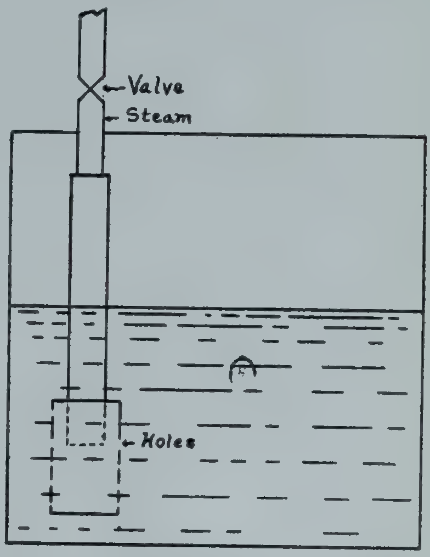
CENTRAL RAILWAY CLUB.

On Nov. 22, J. J. Duguid, general foreman, G.T.R., Toronto, read a paper on "High-speed Steel" before the Central Railway and Engineering Club, Toronto. On Dec. 20, a paper will be read on "Modern Machine Tool Practice for Modern Production," by Gordon C. Keith, managing editor of Canadian Machinery.

NOISELESS WATER HEATER.

By K. Campbell.

The accompanying illustration shows a home-made noiseless water heater. A ½ in. or ¾ in. pipe is expanded into 1 inch pipe. This is expanded into a muffler which is drilled full of holes.



Noiseless Water Heater.

By this arrangement water can be heated very quickly for glue pots or for any other purpose.

Some of the smaller European towns of economical habits have been complaining because they are obliged to light their streets all night for the benefit of a few belated citizens, and have been trying to discover a method whereby the citizen who needs to have his pathway lighted in the small hours of the night shall pay the costs himself. On one of the streets of a small German town, such a system has actually been put into operation. The street is a little over half a mile long, and is provided with nine lamps. At each end of the street is a penny-in-the-slot machine, and whenever anyone wishes to light up the street, he has merely to drop in a ten-pfennig piece, which turns on the current for twelve minutes. This allows him ample time to walk the length of the street. The street is normally lighted until 10 o'clock. Thereafter the prepayment meter must be resorted to.

SEPARATION OF OIL AND WATER FROM STEAM.

It is only within the last few years that the question of separation of oil and water from steam has been given sufficient thought to develop apparatus which will accomplish perfect separation and at the same time not cause an excessive amount of back pressure in the steam lines.

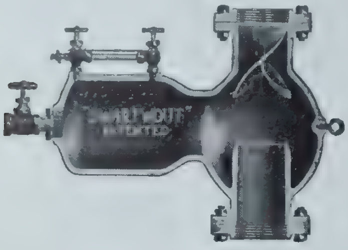


Fig. 1.—Horizontal Centrifugal Separator.

The importance of removing oil from steam before it is condensed and passed again to the boiler is too well known to engineers or those connected with power plants to need remark. Also the loss of efficiency in an engine for every pound of back pressure thrown on the exhaust is well known to engineers. In developing Swartwout separators, a principle of "moral suasion" has been used rather than brute force.

The accompanying cuts show horizontal and vertical up-current, centrifugal separators as designed and manufactured by the Ohio Blower Co., Cleveland, Ohio. It will be noted here that a plate, twisted in the form of a helix, is inserted in the inlet of the separators. This separator is given the helical form as with this curve the particles of steam, oil and water rushing into the separator can be given a violently whirling motion without causing any interference whatever to the flow of the steam. The rifling in the barrel of a gun is helical so that there will be no interference with the flight of the bullet as it is driven out after the explosion of the powder. It is the same with the helical plates in the Swartwout separators.

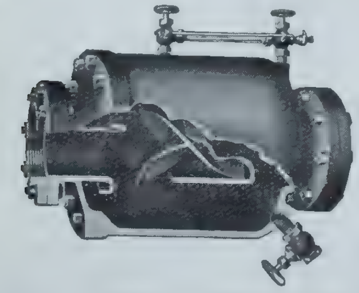


Fig. 2.—Vertical Centrifugal Separator.

The steam, oil and water now enter the body of the separator, which has a considerably enlarged area. The violent whirling caused by the swiftly moving steam, sliding past the helical plate, results in the oil and water, which at atmospheric pressure are in the neighborhood of 600 times as heavy as steam, to fly to the outer walls of the separator, while the dry clean steam is caught by the straight outlet tube inserted well into the body of the separator as shown by the cut. This is extended in so that it will catch the steam before the oil or water has a chance to again get mixed up with the steam.

The separators shown here are both for separating oil in exhaust lines before the exhaust steam passes to the feed water heater. As the ratio between the weight of oil or water and steam increases the lower the pressure, the Swartwout separator becomes more and more effiecient the higher the vacuum. The steam separators are very similar to the oil separators there being merely a little difference in the shape and location of the helical plates. As a combination of centrifugal force and a helical twisting motion is used here, it has been given the name of The Helico-Centrifugal Principle of Steam Separation. It is positive in its action and practically perfect results are secured without choking up the steam lines with a lot of baffle plates.

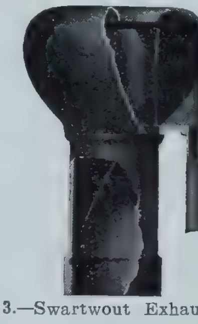


Fig. 3.—Swartwout Exhaust Head.

The same principle has been applied in the Swartwout cast iron exhaust head. One of these is shown in the accompanying cut, Fig. 3. As it is made of cast iron, it will last almost indefinitely.

Not only are these exhaust heads small and neat looking, but by preventing the escape of any condensed steam or oil, it will keep a roof underneath it dry and clean.

Along with the separators and exhaust heads the Ohio Blower Co., manufacturers an automatic safety water gauge, which, although not employing the Helico-Centrifugal Principle, is built on a safe and sane basis. The accompanying cut, Fig. 4, shows one of these water-gauges in which a new glass is being inserted. A feature peculiar to this gauge to no other is the gooseneck construction which permits of a variation in the length of glass inserted of perhaps an inch, much simplifying the cutting of same. This feature furthermore gives a very flexible piece of apparatus, which brings very little strain on the glass itself as the temperature of the gauge rises when a boiler is steaming up. The most important feature, however, of this gauge, is the design of the automatic valves.

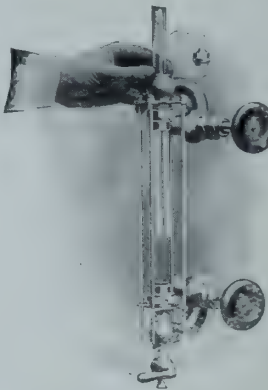


Fig. 5.—Automatic Valve.

These valves, Fig. 5, are of the nature of balanced valves, that is, the steam pressure is kept constantly on both sides of the valve so that when the glass breaks and the pressure on one side is relieved, it snaps shut just as quickly and surely as the emergency airbrakes on a railroad train. Having an equal pressure on both sides of the valves, furthermore makes it very easy to operate in case it is necessary to turn the hand valve. On the end of the valve spindle a scraper is attached which cleans the opening into the boiler every time the valve spindle is turned. Consequently, there is no chance of the opening becoming clogged up and the valve failing to work should the glass break.

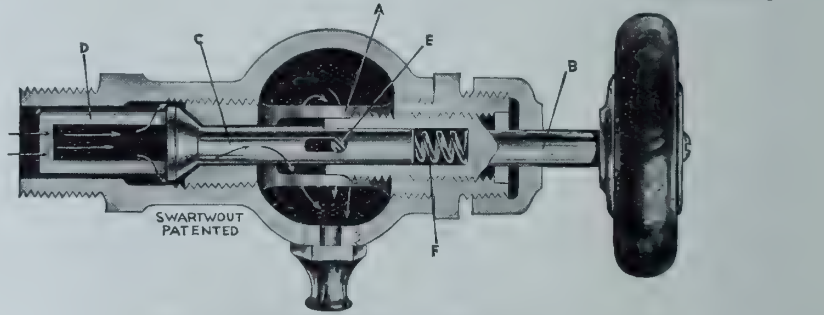


Fig. 4.—Automatic Safety Water Gauge.

REFRIGERATION DEPARTMENT

REFRIGERATION.

By W. G. Walters.

A table of excess condensing pressures for various suction pressures would be of impracticable value, as different makes of refrigerating plants give different results. The high speed (140 revolutions a minute) horizontal compressor invariably gives a greater excess pressure than the vertical compressor, which only has a speed of from 40 to 60 revolutions per minute. The method of connecting the condenser piping affects the excess pressure considerably; thus, if four separate one-inch pipes or worms connected by manifolds are used, the excess pressure will be greater than if one continuous worm, starting at the top with two-inch pipe, reducing to one-inch, were used.

Condensing Pressure.

The condensing pressure is one of the principal means by which we can tell when the loss of ammonia by leakage necessitates the replenishing of the plant. It is very necessary that the engineer in charge, if inexperienced, should keep records of the temperature of the condensed ammonia at its point of exit from the condenser, and the suction and condensing pressures.

If these figures are thoroughly memorized, and the plant starts fully charged with ammonia, he ought to be able at the end of a month or two, to tell by observation of the suction pressure gauge, and condenser ammonia temperature, whether the condensing pressure is what it should be. For example, suppose the plant has been running for two months with an average condensing temperature of 60 degs. Fahr., condensing pressure of 140 pounds and suction pressure of 24 pounds, and that during the next month the condensing pressure gradually fell to 125 pounds, while the condensing temperature and suction pressure remained stationary. It would be plain that neither the condensing temperature nor the suction pressure were accountable for this falling off in the condensing pressure, and that loss of ammonia is the obvious reason, permitting as a consequence the gas a greater length of worm in which to condense and assume the liquid form.

When the condensing pressure falls 5 or 10 pounds, the plant should be recharged with ammonia, to restore the normal condensing pressure.

Direct and Indirect Refrigeration.

In some few cases ammonia is used directly for freezing purposes; the indirect system with brine as a medium, being however most common. The drawbacks to the first system are, that no change of air is possible in the building, and that ammonia leakage from fittings and joints is liable to destroy merchandise, the preservation of which would be the idea for its being there. My experience leads me to suggest the installation of both, with air ducts in all the refrigerators, to insure as low a temperature as may be desired, and have the advantage of a dry atmosphere in the coolers as well.

In buildings where a slight smell of ammonia would not result in pecuniary loss, other than that of the escaping ammonia, which if properly looked after will be exceedingly small, and where the commodities do not require material change in their atmospheric surroundings, it is preferable to cool dircetly. In such a case the expansion valves would be in the building to be cooled, and the ammonia would be expanded in a system of piping hung on the walls or otherwise convenient location. The direct method is decidedly more economical in first cost, obviating the necessity of a refrigerator and its long series of piping, brine pumps and piping, steam connections, etc.

The installation of a combination system gives the advantages of each simultaneously on a machine, provided the piping is properly arranged, and is commendable if first cost is not a serious factor, and a varied class of business is anticipated. Such a plant being more complicated, requires more intelligence in operation, and the man in charge, to get the highest efficiency from it, must know his business from A to Z.

EXPERIMENT ON REFRIGERATING SYSTEM.

By Lewis C. Reynolds.

The permanent gases, which form in a refrigerating system, can be removed in two ways, by burning and by permitting them to escape under water. The former method is only applicable when combustible gases have accumulated to quite an extent, and when they are burned down to a point where it is difficult to maintain the flame, further purging must be done under water.

This is done by attaching a flexible tube to the purge pipe and allowing the gas to escape into water, where the ammonia will be absorbed and any foreign gases will bubble up and break at the surface. With either method some ammonia will escape into the room, and its pungent and far-reaching odor might lead to the belief that a considerable loss was taking place. Experiments conducted by the writer prove, however, that such is not the case.

In preparing to purge the system the liquor in the generator was allowed to boil out until it tested about 19 degrees Baume and in this weakened condition was circulated through the absorber, the expansion valve being closed. Under these conditions the ammonia gas above the liquor in the absorber was more readily absorbed, and to further assist in absorption the liquor was allowed to rise considerably above its normal level in the absorber, which compressed the gas above it.

The purge valve was then opened and the gas ignited; as the flame died down until it was with difficulty kept lighted, a rubber tube being attached and led to the bottom of a three-gallon jar containing cold water. A two-quart wide-mouthed bottle was filled with water and inverted in the jar in such a way that the bubbles of air and foreign gas passed up into the bottle, displacing the water.

After purging in this manner for several hours, the odor in the room was very slight and the density of the water was only raised 3 degrees Baume. This would indicate the loss of ammonia by heavy purging is very little while the large amount of foreign gas removed greatly increases the capacity of the machine, permitting a lower absorber pressure and consequently lower brine temperatures.—Power.

Mills MacLachlan, B.A.Sc., of Toronto, has been appointed city electrical engineer of London.

Most engineers have failed to make good at some time, because they did not use their knowledge in a practical way.

Efficiency does not lie in doing as much as the other fellow does, but in doing as much as you can.

THE POWER HOUSE

A monthly newspaper devoted to the Generation, Transmission and Application of Steam, Gas, Electric, Air and Water Power and to the operation of Refrigerating Machinery.

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Vol. III DECEMBER, 1910 No. 12

C. A. S. E. AND ITS FUTURE.

J. J. Heeg, president of the C.A.S.E., visited the Stratford Lodge No. 30, on Nov. 23. His address to that lodge was full of suggestions for developing a greater interest in the C.A.S.E. It was suggested at the Berlin Convention that the conventions be held bi-annually. Mr. Heeg expressed the opinion that annual conventions kept engineers in closer touch with each other.

Another very important suggestion was that the C.A.S.E. make it known that engineers in charge of gas and electric power plant as well as steam, were welcome to join the association. With the electrical development taking place in Ontario and throughout Canada, engineers will have charge of a great many motors, etc. A great number of industrial plants will be installing electrical machinery in addition to boilers for heating purposes, which will be under their charge. This suggestion is, therefore, an excellent one which should receive the support of the C.A.S.E. executive as well as engineers generally. The C.A.S.E. has always been progressive and any steps to assist brother engineers in gas and electrical lines, will strengthen the foundations for a larger, more useful and popular organization.

◆

POWER PLANT WASTE.

Engineers are beginning to turn their attention to the prevention of waste. It has been pointed out that there is an enormous waste of fuel, for of the 12,000 to 14,000 heat units available in each pound of coal, hardly 1,200 are actually turned into work except where the exhaust steam is made use of for heating purposes. The waste of fuel, however, is only one of a great number of wastes going on continually in a large number of plants. There are those due to the design of the plant, but they are difficult to correct. There are also wastes in operation which may be corrected.

There are wastes of water, fuel, oil, labor, steam, etc. One waste in fuel is the smoke: The elimination of this is one saving though perhaps in some cases small since the percentage of volatile matter in the coal is small. In eliminating smoke, however, other improvements are often made which effect great savings. Grates should be designed for the coal used and sufficient air space should be provided. Tubes should be kept clear of soot and the boiler kept in proper condition to allow a quick transfer of heat.

A poor fireman is an expensive luxury. One who throws in great quantities of fuel at a time, letting the fire get thick in spots, will greatly increase the fuel bill. Low grade fuel with a properly designed furnace will give better results than in those plants where "the best is none to good for us." This is not always recognized.

The heating of water before entering the boiler or pumping water through an economizer are other methods whereby savings may be effected if not already followed.

Leaky valves, leaky rivets in boilers, waste due to poor lighting engineering and from low efficiency carbon lamps are other points that should be looked after. By careful choice of the kind of lights and reflectors, great savings may be made.

In fact the engineer has got to keep his eyes open if he is to make a name for himself in producing power cheaply. The one who does should be rewarded. One basis that has been proposed is the amount of work an engineer can produce from a certain quantity of coal. That is, if a standard of 1,200 heat units is secured from a pound of coal containing 12,000 heat units and the engineer produces work equal to 1,300 heat units, he should be rewarded. Recognizing the services of an engineer in this way will keep him on the alert to discover waste in the plant and eliminate it.

◆

PEAT AS FUEL.

The popularity of peat as a fuel has been recently demonstrated to a surprising degree at Ottawa. Some 550 tons of peat fuel, the product of the Government peat plant at Alfred, a little village 40 miles from the city, was put on the market a few weeks ago and a deluge of orders poured in from citizens. The supply available could not begin to satisfy the demand. Two thousand orders that could not be filled were received. At the Central Canada Exhibition this fall, the Mines Branch, which has charge of the peat experiments, had a practical demonstration of peat being used for fuel. That the demonstration was successful is evidenced by the way the supply was snapped up almost as soon as put on the market.

The success of the Government peat plant points favorably to the profitable manufacture of peat on a large scale by private capital. The Mines Branch put its peat on the market at the cost price of $3.25 per ton delivered. The cost at Alfred was $2.25 per ton, and the freight from Alfred to Ottawa is 90c per ton. However, as 1.8 tons of peat are equal in fuel value to 1 ton of anthracite which sells at Ottawa for $6.50 per ton, there was a clear gain to those who bought peat at $3.25. Moreover, peat lights easily and makes a quick hot fire. It retains fire a long time, leaves a very scanty ash and is supplied in a handy briquette form.

Numerous attempts to utilize peat bogs in Canada have been made by private individuals and almost without exception these have proved failures. So much so is this the case that capital is very chary about investing in peat ventures. Most of these failures have been occasioned by ignorance. The properties of peat were not sufficiently known by those attempting to manufacture it and very often bogs were chosen that contained a quality of peat not suited to the purpose in view. One of the great hindrances to success has been the lack of careful investigation of bogs before expending money on development. The Department of Mines, under the direction of Dr. Eugene Haanel, has endeavored to remedy this situation. Peat bogs are being explored and mapped, the peat is being tested as to quality, and peat experts from Europe have been secured who are in charge of the experimental plant for the manufacture of the fuel. These careful, scientific efforts are now being crowned with success.

Peat fuel is considerably more bulky than coal and it is not thought that it could be profitably transported long distances. The peat bogs in Ontario and Quebec, however, are very favorably distributed and since a plant with a daily capacity of 30 tons can be erected for about $7,000, these could be profitably developed to supply local need.

◆

EDUCATIVE VALUE OF ADVERTISEMENTS.

When a man has had a good meal he likes to top it off with a good dessert. If, therefore, the engineer neglects to peruse carefully the catalogue reviews and the advertisements, he misses a delicious dessert to his intellectual meal. In each issue of The Power House, information is given in the advertisements, which should make the engineer and the boss sit down and do some thinking. Take an advertisement for babbitt metal, smoke consumer, heater, boiler, belting, pulleys, etc., and you you will usually find statements made that are worth pondering over. As an example: "We can keep your boiler tubes and grate bars clean, reducing expense of upkeep." The purifier "effectively extracts all oil and grease from exhaust steam." The statements made in the many advertisements are not made in a hap-hazard manner. They are made by reputable firms with reputations to sustain. The possible economies obtainable by the installation of different appliances and devices advertised is worth looking into and the advertisements are a real fund of information on them.

Further, catalogues are becoming real text books and engineers will find those referred to in the reviews and advertisments of real educational value. The data is for the most part accurate and reliable. In these catalogues the construction of the various power devices are described and clearly illustrated by means of half-tones and line drawings. Many of the large manufacturers have publicity departments and will supply catalogues, circular matter, etc., about devices advertised, if the engineer will make an investment of a one cent postal.

There is practically no other way in which an engineer may keep in close touch with developments in power equipment; the advertisements are prepared by manufacturers who understand the apparatus and the engineer who wishes to be in touch with modern practice will watch the advertisements carefully. Those who do, will become the best informed men in the profession and men in whom the boss will place every confidence when new equipment is being purchased or changes are being made in the power equipment of the factory or power plant.

◆

POWER COSTS.

In some plants, the cost to produce power is not known. In fact no attempts have been made to keep records. Coal has been ordered by the office. It is used by the engineer and when the supply runs short, he goes to the telephone and tells the order department the state of the coal pile. It is the same when a valve or other piece of equipment is ordered. The bill comes in in due time, is paid for and the voucher filed away. No attempt is made to find out the cost per year to produce power.

In other plants very loose methods are followed. So much coal is ordered; the labor cost so much; we used so much power (estimated), therefore we produced our power at so much per horse power. In other words they they are "going it blind" and there is nothing definite to show the cost.

Engineers should be alive to the cost of producing power in his plant or perhaps some other nearby concern with surplus power to sell, will come along and make an offer to your company to supply power at a certain rate per house power per year. Unless you keep a log book or daily cost data sheets, you will not be in a position to argue with this competitor and in a short time there will be another reader of the condensed advt. pages of the daily papers.

TO the friends of The Power House at home and abroad, we present, at this joyous season, our heartiest good wishes for a Happy Christmas and a Prosperous New Year.

The Editors and Managers, December, 1910.

TOPICS OF THE MONTH.

Engineers are beginning to recognize the value of rubbing shoulders with their brothers in the profession, discussing questions of interest and meeting in a social way. It is in this way that engineers become better acquainted with their work.

* * *

The importation of electrical fittings into South Africa for the first seven months of 1910 amounted to $1,110,000 in comparison with $386,000 for similar supplies during the first seven months of 1909. Canadian electrical companies desirous of extending their foreign connections would no doubt find good openings for trade in South Africa.

* * *

Manufacturers are making their catalogues more useful to engineers by the addition of data for use in connection with the apparatus manufactured by them. There has been a marked improvement in the catalogues received at the desk of the editor during the past few months.

* * *

A freight classification went into effect on Nov. 15. Fifty-five articles previously not listed, were classified and reductions made in nearly all cases. Only two increases were made in electrical goods. Dynamos and parts, and motors and parts, less than carload have been advanced to No. 1 class. To counterbalance this, however, the same goods in carloads have been reduced from class 5 to 6. As motors and dynamos are largely shipped in carloads, shippers do not suffer by this change.

* * *

Municipal advertisements are dropping their references to "smoking" chimneys showing that engineers are "on the job."

* * *

We have received a great number of requests, especially from Ontario subscribers, for a set of questions and answers which will enable those who wish to obtain engineering certificates, to write off the examinations. A subscriber has compiled a number of questions and answers, which we trust will assist them in the study of steam engineering.

POWER PLANT DEVELOPMENTS

News of Industrial Developments Requiring Steam, Gas, Electric, Air or Water Power Equipments—Municipal Power Undertakings.

British Columbia.

VANCOUVER—Work is in progress on the extension of the steam auxiliary power plant of the British Columbia Electric Railway Co. at the rear of its Main Street substation and shortly a large increase in the amount of power from this source will be available. The initial equipment at the steam auxiliary plant provided for 8,000 horsepower and the additional plant now being installed will advance this output to 12,000 horsepower. The generator and steam turbine are already installed and the remaining equipment is now on hand and will be installed at once.

VANCOUVER—In order to cheapen the production of gas in the city, the Vancouver Gas Co., a subsidiary corporation to the British Columbia Electric Railway Co., is preparing to construct a new gas plant on deep water frontage.

Alberta.

CALGARY—The wires of the electric lighting system are gradually being placed under ground. Two miles of conduits for electric wires were laid this summer and this will be increased by a considerable mileage next year.

CALGARY—William Kennedy, jr., of Montreal, hydraulic engineer, has been decided upon by the power committee to investigate the power possibilities of the Bow and Elbow and other adjacent rivers for the benefit of the city of Calgary.

RED DEER—A hydro-electric plant will be installed here.

Manitoba.

WINNIPEG—The Manitoba Bridge & Iron Works, is in the market for a belt-driven air compressor of 700 cubic feet capacity.

GRETNA—A new electric lighting plant will be installed.

Ontario.

TORONTO—The Carbon Oil Works, Winnipeg, have been given a license to establish in Ontario, with head office in Toronto, the capital stock not to exceed $40,000.

ALEXANDRIA—The Eastern Pipe and Construction Co., has been incorporated, with a capital stock of $50,000 to carry on the manufacture of wire-wound wooden water-pipe and continuous stave pipe in Alexandria.

OTTAWA—A company has been formed of which the provisional directors include R. McElroy, M.L.A., Carp; F. A. Heney, Westboro; Ald. J. S. McCann, Kingston, and E. P. McGrath, Ottawa. A charter will be asked for to construct an electric railroad between Ottawa and Kingston, passing through Smith's Falls, etc. Mr. F. B. Proctor, Trust Building, Ottawa, is the solicitor.

OTTAWA—Henry Holgate, C.E., of Montreal, with others, have conferred with the engineers of the Railways and Public Works Department in order to once more present to them the plans of the Long Sault Development Co. Mr. Holgate states that there are no new features in the plans and that there is no proposal to alter the general scheme of leaving the whole control under the Canadian Government.

SMITH'S FALLS—A by-law will be submitted on Jan. 2 to raise $10,000 for the installation of a turbine water wheel and pump.

DUNDAS—A by-law will be submitted on Jan. 2 to raise $12,000 for the purpose of installing Hydro-electric power and light. The council will negotiate with the Dundas Electric Co. for the purchase of their lighting plant.

TORONTO—Hydro-electric power will be turned on here on Dec. 27.

HAMILTON—The Canadian Tungsten Lamp Company's new wing on Cannon Street, is nearly completed, most of the interior fittings being now in place. This makes the third wing that has been added to this progressive plant within a year. This increased accommodation provides more than one-third more floor space and with the new machinery, which is of the latest and most up-to-date character, will more than double the output.

THOROLD—On Jan. 2 a by-law will be submitted by which the Ontario Power Co., Niagara Falls, is empowered to supply the manufacturers, corporation, etc., with water and electric power.

Quebec.

MONTREAL—The Canada Ford Co., owing to pressure of space have removed from their offices in the Canadian Express Building, and will hereafter occupy the entire building at 485 St. James Street (a few doors west of Inspector), Montreal, where they will carry a complete line of the products of the Brush Electrical Engineering Co., of Loughborough, England, as well as ventilating fans and blowers.

SHERBROOKE—The Street Railway Co is building a new power house.

MONTREAL—The council at its last meeting awarded to the John McDougall Caledonian Iron Works Co., of Montreal, the contract for a motor driven centrifugal pump of 5,000,000 gallons capacity for $7,716. The unit consists of a 16 inch two stage turbine pump driven by an Allis-Chalmers-Bullock 500 H.P. wound rotor motor.

MONTREAL—The Blackburn-Smith Feed Water Filter and Grease Extractor, manufactured by James Beggs & Co., of New York is now being marketed in Canada by Eadie-Douglas, of Montreal, Toronto, Winnipeg, Vancouver, Ottawa and Quebec. This filter is already well-known in Canada where numerous installations have been in service for years in government and municipal service and in the power plants of the leading factories and office buildings.

SAULT AUX RECOLLET—$80,000 will be spent on waterworks machinery.

MONTREAL—$2,300,000 will be spent on waterworks and filtration equipment.

ST. HYACINTHE—The Colonial Engineering Engineering Co., Montreal, have secured the contract for the complete lighting and pumping equipment for this city.

New Brunswick.

MONCTON—Canada Gazette gives notice of the incorporation of a new pulp and paper company which will develop the Grand Falls under the name of the Grand Falls Co., with a capital stock of $1,200,000. The incorporation includes Sir William Van Horne, H. S. Holt, president of the Royal Bank of Canada; George F. Underwood, vice-president of the International Paper Co., of New York. The new company will soon be in a position to go ahead with their development work. Plans have already been prepared and the preliminary arrangements made so that within a year the work will be actively in progress.

Awarded Silver Medal.

Jones & Glassco, St. Nicholas Bldg., Montreal, have been awarded the silver medal for their exhibit of transmission machinery at the Canadian National Exhibition, Toronto, 1910. The exhibit included Renold chain drives and Kenyon rope drives. The Silver Medal is the highest award. Harris Renold, Manchester, Eng., their principals, have been awarded the Grand Prix at the Brussels Exposition, 1910.

Bird-Archer Calendar.

A sea-shore girl waving a flag bearing the trade-mark used on Bird-Archer marine boiler compounds, to a passing ship is the attractive picture of the 1911 calendar issued by the Bird-Archer Co., 90 West St., New York. The trade-mark of boiler compounds for stationary boiler is also in evidence.

McAvity Steam Specialties.

An interesting feature of the catalogue recently issued by T. McAvity & Sons, St. John, N.B., is the description, with illustrations, of the World-Goetze copper gaskets, Victor "200" value discs and packings. The gaskets are made up of alternate walls of copper and asbestos, their construction being clearly shown in the colored illustrations. Other specialties featured in the catalogue are "Vitite" compressed high pressure steam packing, globe valves, injectors, etc. Prices of the specialties are included in the catalogue making it a valuable one for engineers.

Canadian Tungsten Lamp Co. in Vancouver.

The Canadian Tungsten Lamp Co., Hamilton, Ont., have made arrangements with the Hinton Electrical Co. to represent them in British Columbia. Stocks of the "Kolloid-Wolfram" tungsten lamps and of all kinds of "Brilliant" carbon lamps will be carried at 606 Granville St., Vancouver, and 911 Government Street, Victoria.

Gas Engines and Suction Gas Plants.

H. W. Petrie report a large demand for Keighley gas engine and section gas plants and a continued record of satisfaction from Canadian users. The installations on hand at present comprise a 65 horse power suction gas plant with engine and 42 k.w. Lancashire generator for Mount Albert, a 48 horse power plant similar to above for the Faircloth Art Glass and Decorating Co., Toronto, a 60 H.P. plant for Hallman & Co., Toronto, a special type gas engine, direct connected to a Lancashire generator, and operated by city gas, for the Consumers Gas Company, Toronto, for the purpose of supplying electric light at the company's eastern works. We hope in a later issue to be able to give a descriptive account of this latter installation, and to furnish some data on its operation. It speaks well for the Keighley engine that the Consumers Gas Co. have confidence in its ability to operate with profit to them, and opens up wide possibilities of usefulness in a like direction. Besides the foregoing, orders are on hand for 75 and 65 H.P. gas engines to operate with natural gas, from the Sutherland Wire Fence Co., Sarnia, and from Mr. Wemp, Wheatley, Ont.

Trade Notes.

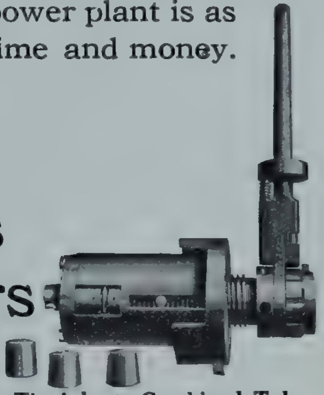
The Elliott Co., of Pittsburg, Pa., has recently acquired the entire business, patents and good will of the Pittsburg Feed Water Heater Co., Pittsburg, Pa., and will in the future be the sole manufacturers of the well-known Pittsburg Feed Water Heater, including the three types; namely, the vertical, horizontal and closed, and will be able to supply heaters in units from 100 H.P. up to and including 30,000 H.P.

The Liberty "Cyclone" Tube Cleaner

You need these tools---their presence in your power plant is as good as a policy of insurance against loss of time and money.

"LIBERTY"

Boiler Tube Cleaners Combined Tube Cutters and Expanders



The Liberty Combined Tube Cutter and Expander

"Liberty" Tube Cleaners are made in several types and sizes to take care of different weights of scale. They can be operated by steam or compressed air with equally satisfactory results.

The "Liberty" Combined Tube Cutter and Expander is the most effective tool in the world for cutting, trimming and expanding boiler tubes. No boiler plant can afford to be without it.

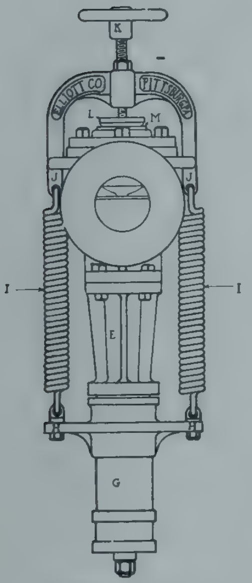
Write us for Illustrated Bulletins

Liberty Manufacturing Co.

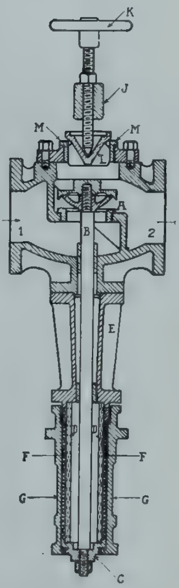
6902 SUSQUEHANNA STREET
PITTSBURG, PA., U.S.A.

The ELLIOTT Reducing Valve

"The Reducing Valve Without a Diaphragm."



Type "A."



Type "A."

THE old-fashioned type of diaphragm reducing valve, owing to its well-known and irremediable disadvantages, is rapidly being displaced the world over by the "ELLIOTT."

The ELLIOTT type of reducing valve is no experiment. It is used extensively in Great Britain, Germany and elsewhere and has been for many years. When we were looking for the most perfect type of Reducing Valve to manufacture in this country, there was "nothing to it" but the ELLIOTT type—it was so obviously the best in the world.

Made in two styles—Type "A" with combined relief valve and Type "B" without relief valve

Write for Our Illustrated Bulletin.

ELLIOTT COMPANY

6902 Susquehanna Street - PITTSBURG, PA.

CATALOGUES.

WATER HEATER—A folder from Laurie & Lamb, Board of Trade Bldg., Montreal, describes the operation and construction of the Laurie heater and purifier. This will be mailed to engineers on request.

PUMPING MACHINERY—The American Steam Pump Co., Battle Creek, Mich., have issued a 188 page catalogue, No. 18, on coated paper describing Marsh steam pumps, American simple and compound pumps, American power pumps and air compressors. The catalogue is divided into sections, Part I dealing with Standard boiler feed pumps, part II tank and vacuum pumps, part III air compressors, part IV deep well pumping engines, part V automatic feed pumps with receiving tanks and float governors, part VI pumps for sugar house work, part VII Marsh sinking pumps, VIII creamery pumps, IX other Marsh pumps, X American simple and compound pumps, XI American power pumps and compressors. A number of useful tables are included in the catalogue.

FRICTION CLUTCHES—The Carlyle Johnson Machine Co., Manchester, Conn. Catalogue "E," 1911, 35 pages, 4½" x 7". An issue of 25,000. The catalogue is enclosed in a handsome cover of two-toned blue, with a clutch cut and company monogram embossed thereon, and is filled with attractive illustrations showing the Johnson Clutch factory views, etc. The inside pages have an attractive blue border to correspond with the blue cover, this border being made up of reduced cuts of Johnson Friction Clutches.

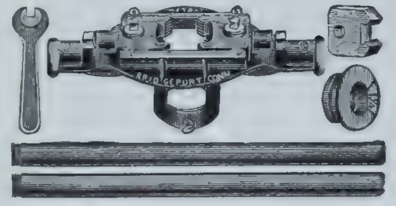
This catalogue is larger and more complete than previous ones, and deals almost exclusively with the driving of machinery through friction clutches, special attention being paid to the driving of machinery from line shafting, thus eliminating cross belting, countershafting, etc. There is special mention made of clutches for cut-off coupling work for use in connection with marine motors, as a one-way clutch for which work this type of clutch is particularly adapted. The lists are very complete, extending to clutch part, which are numbered to correspond to the numbers indicating the parts on sectional views. Copies will be sent free to interested parties.

WATER SOFTENING—Laurie & Lamb, Board of Trade Bldg., Montreal, have an excellent treatise and catalogue of 46 pages on the Paterson system for water softening and purifying for steam raising and industrial purposes. The catalogue fully describes in colors the features of the Paterson and gives a treatise on water softening making it a valuable reference book on the subject.

IMPERIAL
HYGIENIC
Cotton Wipers

Now used over three years by the largest Electric, Power and Water Plants in Canada, with most satisfactory results.
Cleaner, cheaper and more convenient than waste and absolutely free of dust.
Unexcelled for cleaning and polishing engines, motors, dynamos, pumps, etc.
Every piece a wiper.
Samples gladly sent on request.

The Imperial Waste & Metal Co.
Office and Works:
5-13 Queen Street : MONTREAL
The Wipers you will eventually use.



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ARMSTRONG STOCKS
AND DIES
FOR CUTTING PIPE & BOLTS
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PIPE MACHINES
PIPE CUTTERS
HINGED PIPE VISES
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METAL POLISH
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SOLD ALL OVER THE WORLD

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Write us for your requirements in MICA

Burn Cheap Coal
AND
Save Money
BY USING A
"Turbine Fan"
Made by
PERCIVAL F. GIFFORD
505 Power Building : Montreal

You've Got to Use Some Lubricant. Then Isn't a Little Investigation on the Subject Worth While?

Do you know that Dixon's Flake Graphite absolutely prevents abrasion?

Intense heat has no effect upon it, neither has intense cold.

Acids or alkalies do not alter Dixon's Flake Graphite in any way.

Oil or grease alone cannot stand any such tests as Dixon's Flake Graphite easily meets.

That's why engineers use Dixon's Flake Graphite in their work—it does what no other lubricant can do.

Write for Free Sample 223-C

Joseph Dixon Crucible Co.
Jersey City, New Jersey

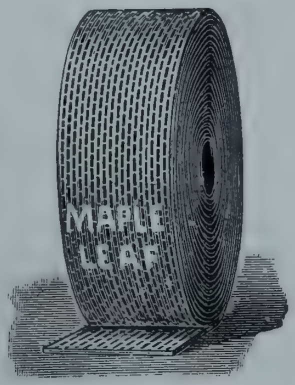
Eugene F. Phillips Electrical Works, Limited
MONTREAL CANADA
Bare and Insulated Electric Wire
Electric Light Line Wire. Incandescent or Flexible Cords.
Railway Feeder and Trolley Wire
Americanite, Magnite, Office and Annunciator Wire. Cables for Aerial and Underground Use.
HALIFAX TORONTO WINNIPEG VANCOUVER

DOMINION BELTING CO., Limited
HAMILTON, CANADA
SOLE MANUFACTURERS OF THE CELEBRATED

"MAPLE LEAF" BRAND
Stitched Cotton Duck Belting

FOR TRANSMISSION OF POWER, CARRYING, ETC.
THE TRUEST RUNNING

THE STRONGEST



THE MOST ECONOMICAL BELT

MADE IN CANADA

As a Main Drive Belt "Maple Leaf" cannot be excelled. Write for prices.

"MAPLE LEAF" BELT DRESSING is the best on the market for all kinds of belts.

This Belt Formerly Ran Tight and Kept the Engineer Busy all the Time. See How it Acts After Cling-Surface Treatment.

This 8-in. single-ply leather belt runs from 22-in. driving to 30-in. driven pulley on 10-foot centres and at a speed of 1,350 feet per minute, carries irregular load up to 20 h.p. and is subject to dampness.

Before using Cling-Surface the belt had to be run so tight that several fillings of the oil cups on the engine were required daily.

Now, since Cling-Surface is being used, the belt is pliable and clean, proof against dampness, carries full load without slip, **runs with a sag of two feet,** and the engine bearings remain cool with one filling of the oil cups per day.

A belt properly treated with Cling-Surface and run slack will often break before slipping, never gathers dirt on the outside, is waterproof and rarely or never needs tightening. Try Cling-Surface on one or two belts.

Cling-Surface Co.

1057 Niagara Street Buffalo N Y
New York Chicago Boston Memphis
St. Louis Denver Atlanta Toronto Ont
London—Thomas & Bishop 119-125 Finsbury Pavement E C

"IDEAL" COMBINATION SPLIT PULLEYS

Toronto, March 31st, 1909.

Gentlemen,---Your combination Pulley, 36 in. diameter and 8 in. face, has been tested in the Mechanical Laboratory of the Toronto University, to transmit 20 H.P. at 100 R.P.M., being the rated maximum power of an 8-in. double leather belt, based on a belt pull of 90 lbs. to the inch.

The Malleable Hub and Cast Iron Bushings enabled the pulley to transmit the entire power by compression without the use of keys.

The following is a report on the power consumed in windage, weight and balance by your pulley in comparison with a Standard Wood Pulley of the same size.

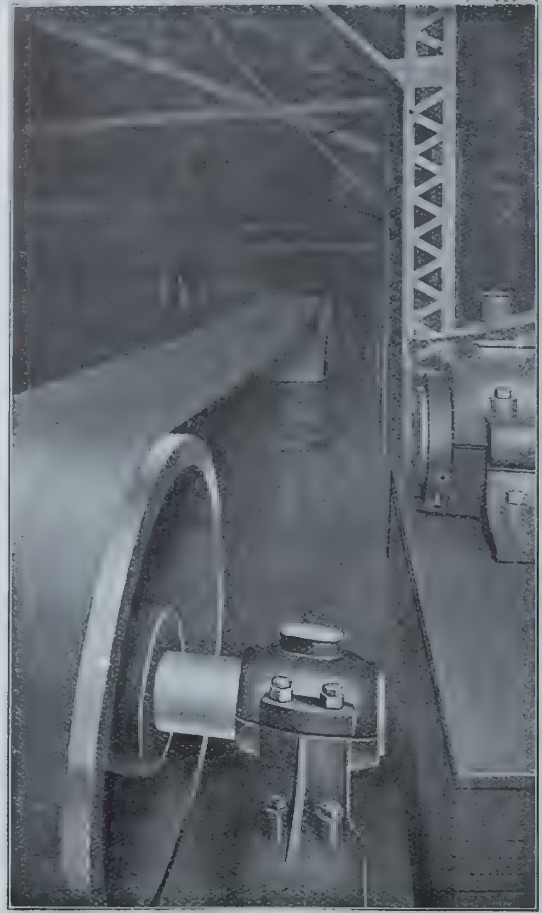
Style of Pulley	Watts Consumed		Windage		Weight and Balance	
	Sides Uncovered	Sides Covered	Watts	H.P.	Watts	H.P.
Wood - - - - -	1683	1463	220	.298	85	.114
Combination - - -	1409	1405	4	.005	27	.036

This test was performed with shaft running at 400 R.P.M., at which speed the Watts consumed to run shaft free of pulleys were 1378.

Yours truly,
W. W. GRAY,
Demonstrator.

Write us for full particulars and Illustrated Catalogue.

The Positive Clutch & Pulley Works, Limited
11-13 Jarvis Street, Toronto, Ontario



SCANDINAVIA BELTING

FOR CONVEYING AND TRANSMISSION

Not affected by WATER,
STEAM, OIL or DUST.

Made in three thicknesses and up to 66 inches wide. It is a SOLID belt, and NOT made in plies.

Write for Bulletin E and discounts.

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Limited
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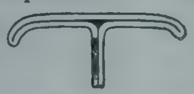
The Philips Pulley provides perfect BELT TRANSMISSION because of the unbroken surface of the Pulley face (no rivets or grooves), which is composed of a single sheet of steel, pressed in a double thickness thus,  forming a strong rim with central rib and to which are attached Corrugated Steel Arms of BRIDGE OR TRUSS CONSTRUCTION, which is recognized to provide the greatest resistance to strain transfer. These Arms are supported by a Split Cast Iron Hub of substantial proportions, giving absolute rigidity on the shaft. The hubs are bored and reamed a perfectly true fit to the shaft and adhere by compression. We have not heard of a single case of slip.

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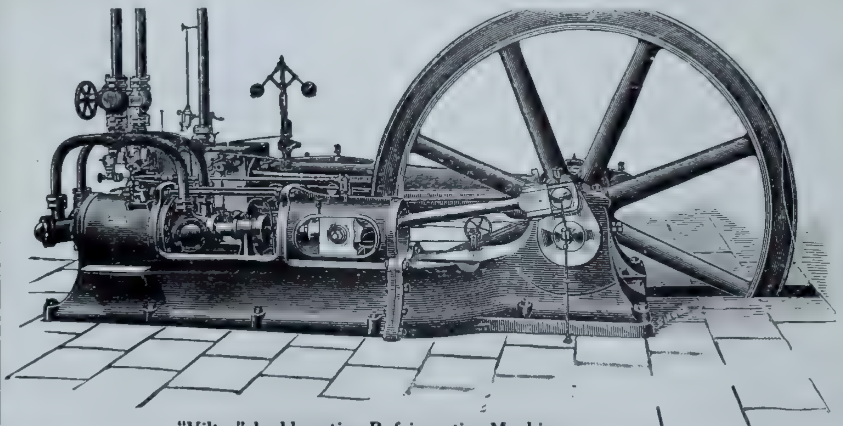

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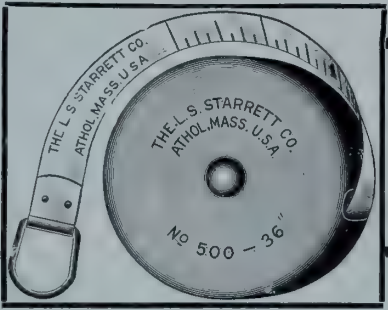
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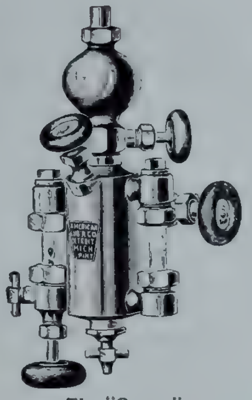

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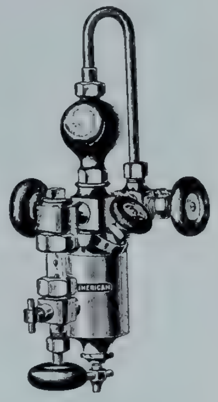

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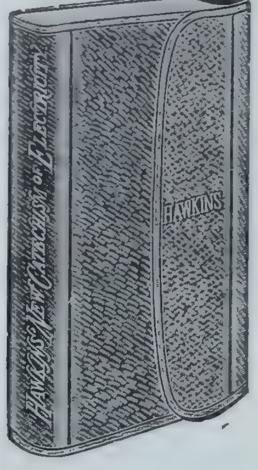

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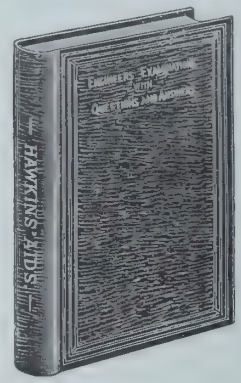

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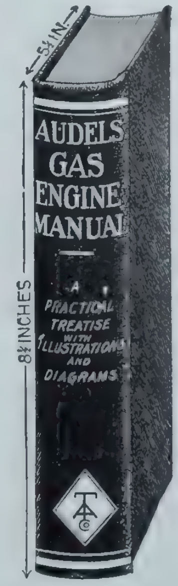

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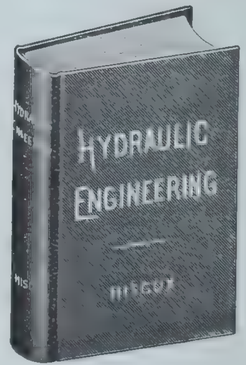

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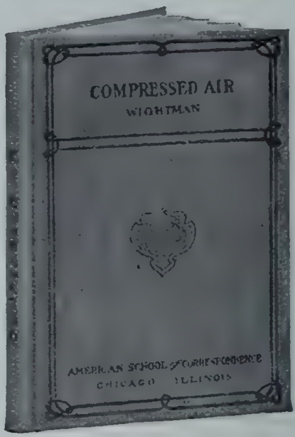

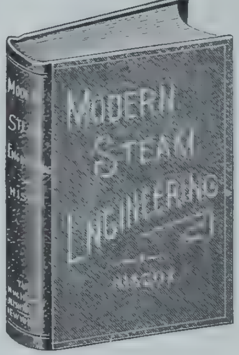

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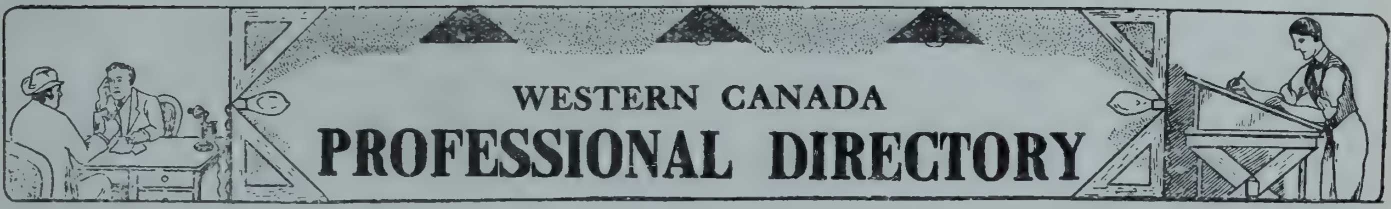

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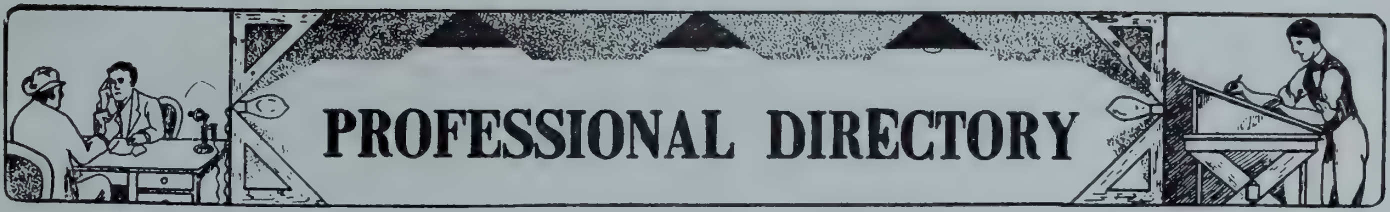

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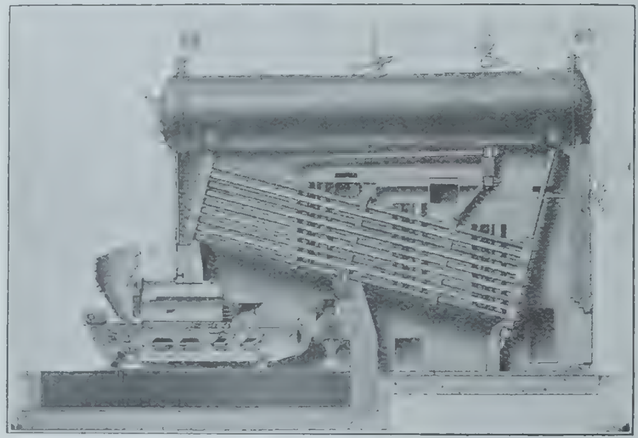

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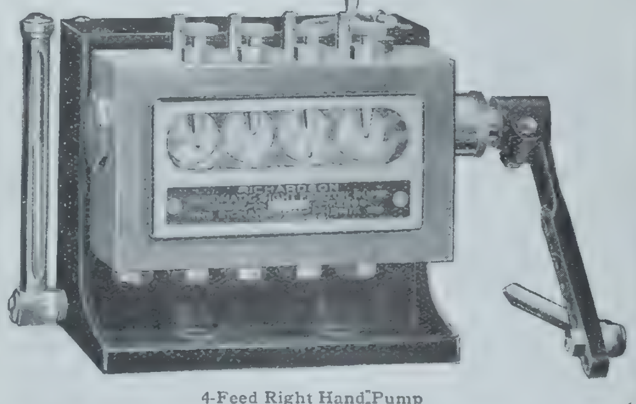

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The John Inglis Co., Ltd., Toronto
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The Stewart Heater Co., Buffalo, N.Y.

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Hose Steam.

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Lubricators, Plain.

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American Lubricator Co., Detroit

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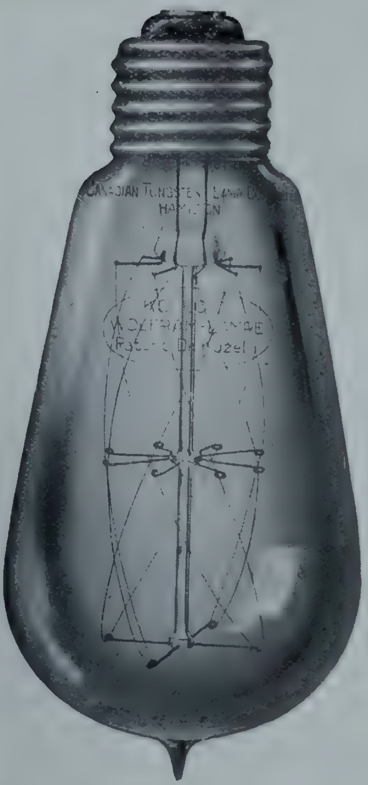

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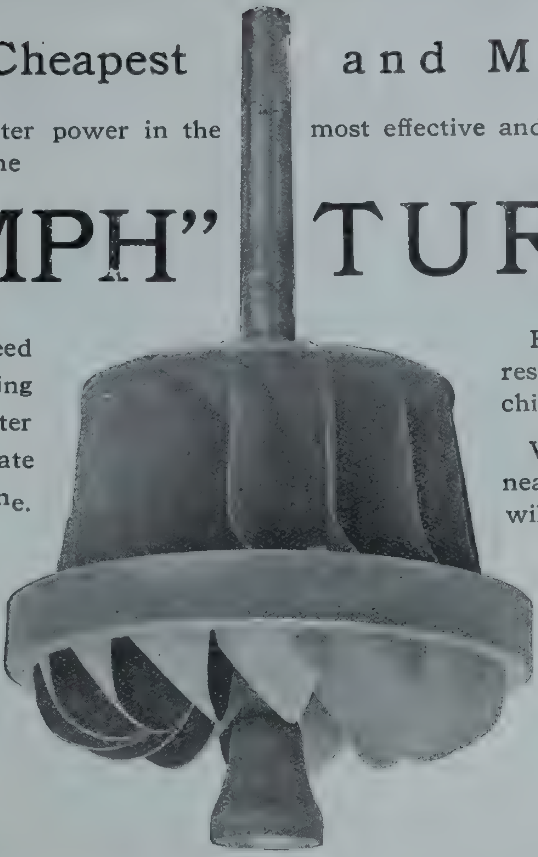

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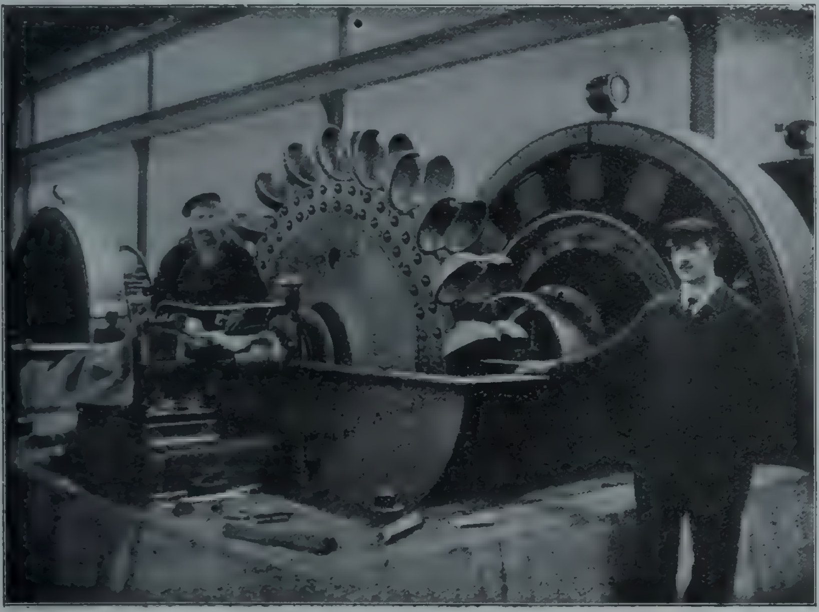

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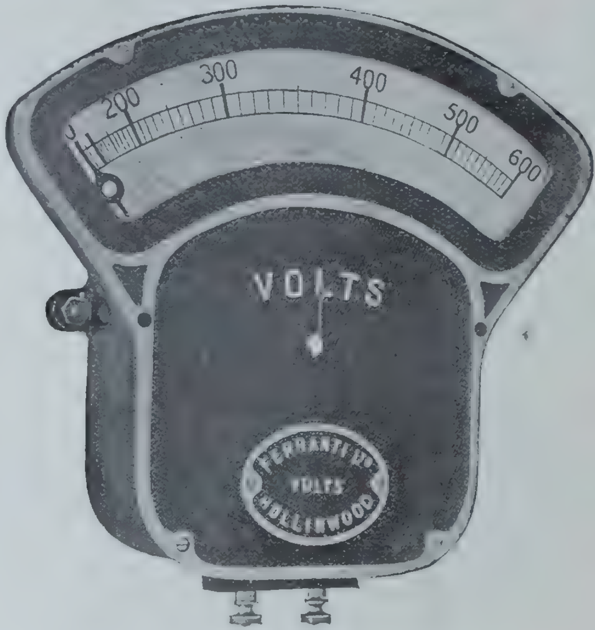

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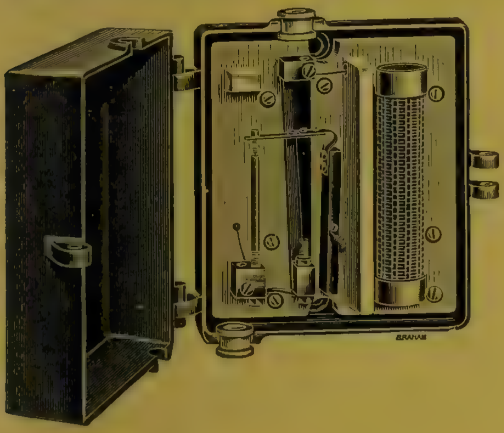

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